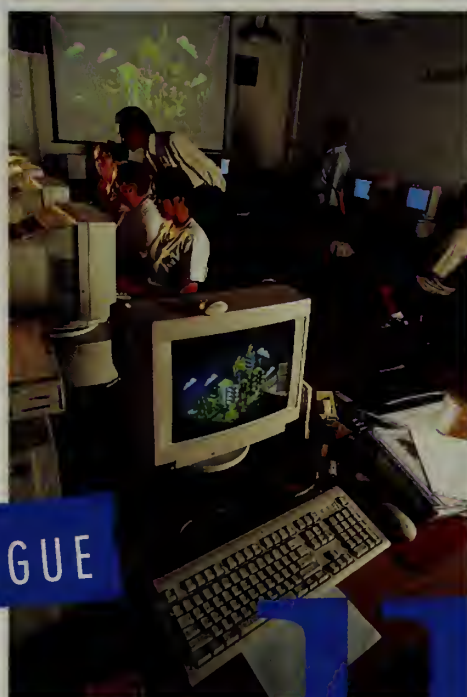


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UNDERGRADUATE CATALOGUE

Lowell

UNIVERSITY OF MASSACHUSETTS LOWELL

▲ Accounting ▲ American Studies ▲ Art ▲ Biological Sciences

▲ Biotechnology ▲ Chemical Engineering ▲ Chemistry

UNDERGRADUATE CATALOG

▲ Civil Engineering ▲ Clinical Laboratory Sciences ▲ Computer Science

1997 - 1999

▲ Criminal Justice ▲ Economics ▲ Electrical Engineering ▲ English

One University Avenue

▲ Environmental Sciences ▲ Exercise Physiology ▲ Finance ▲ Fine Arts

Lowell, Massachusetts

▲ Geology ▲ Graphic Design ▲ Health ▲ Health Education ▲ History

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▲ Humanities ▲ Industrial Management ▲ Liberal Arts ▲ Management

▲ Manufacturing and Information Systems ▲ Marketing ▲ Mathematics

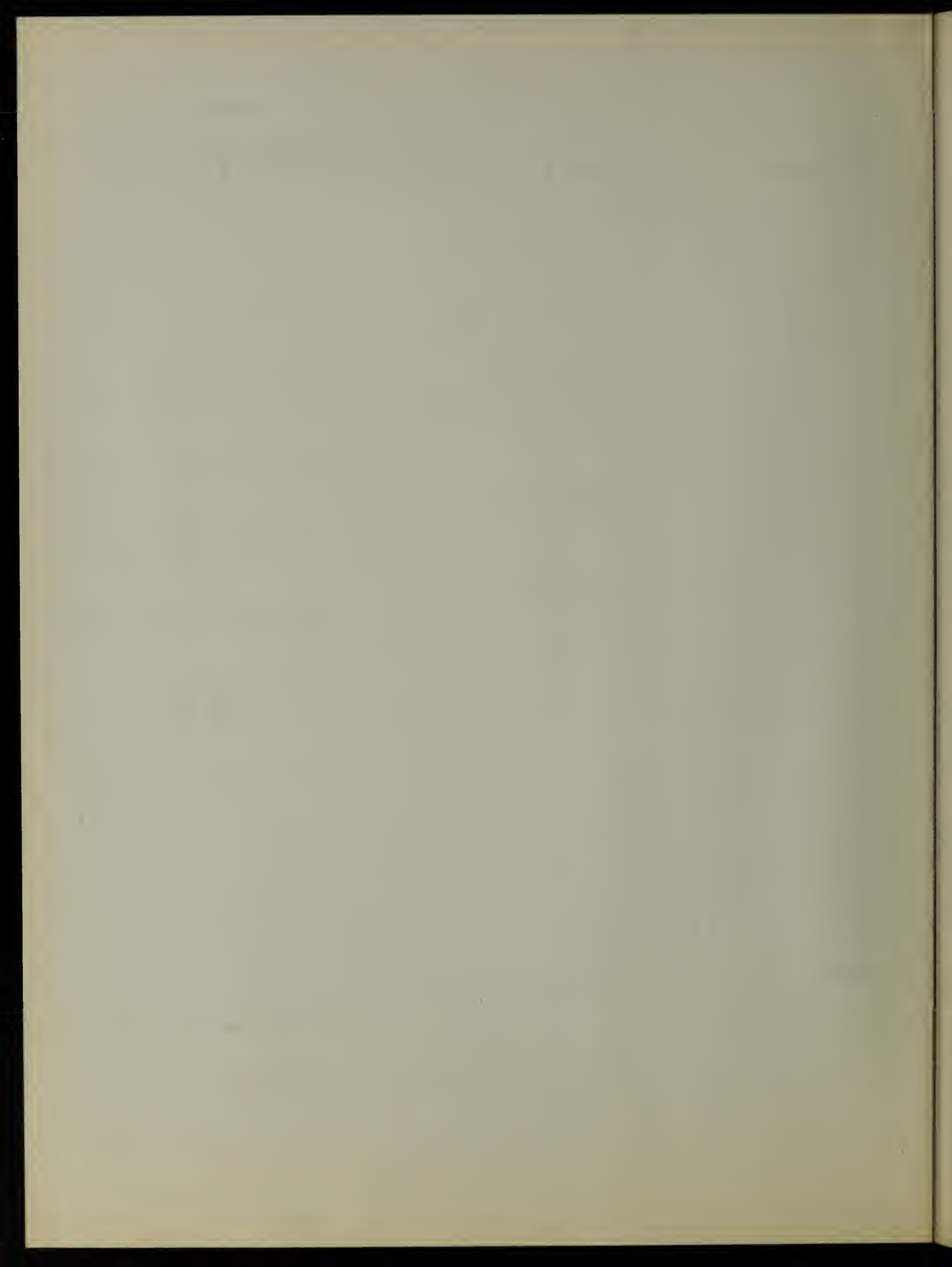
▲ Mechanical Engineering ▲ Medical Technology ▲ Meteorology

▲ Modern Languages ▲ Music ▲ Music Business ▲ Music Education

▲ Nuclear Engineering ▲ Nursing ▲ Philosophy ▲ Physics

▲ Plastics Engineering ▲ Policy and Planning ▲ Political Science

▲ Psychology ▲ Social Sciences ▲ Sociology ▲ Sound Recording Technology

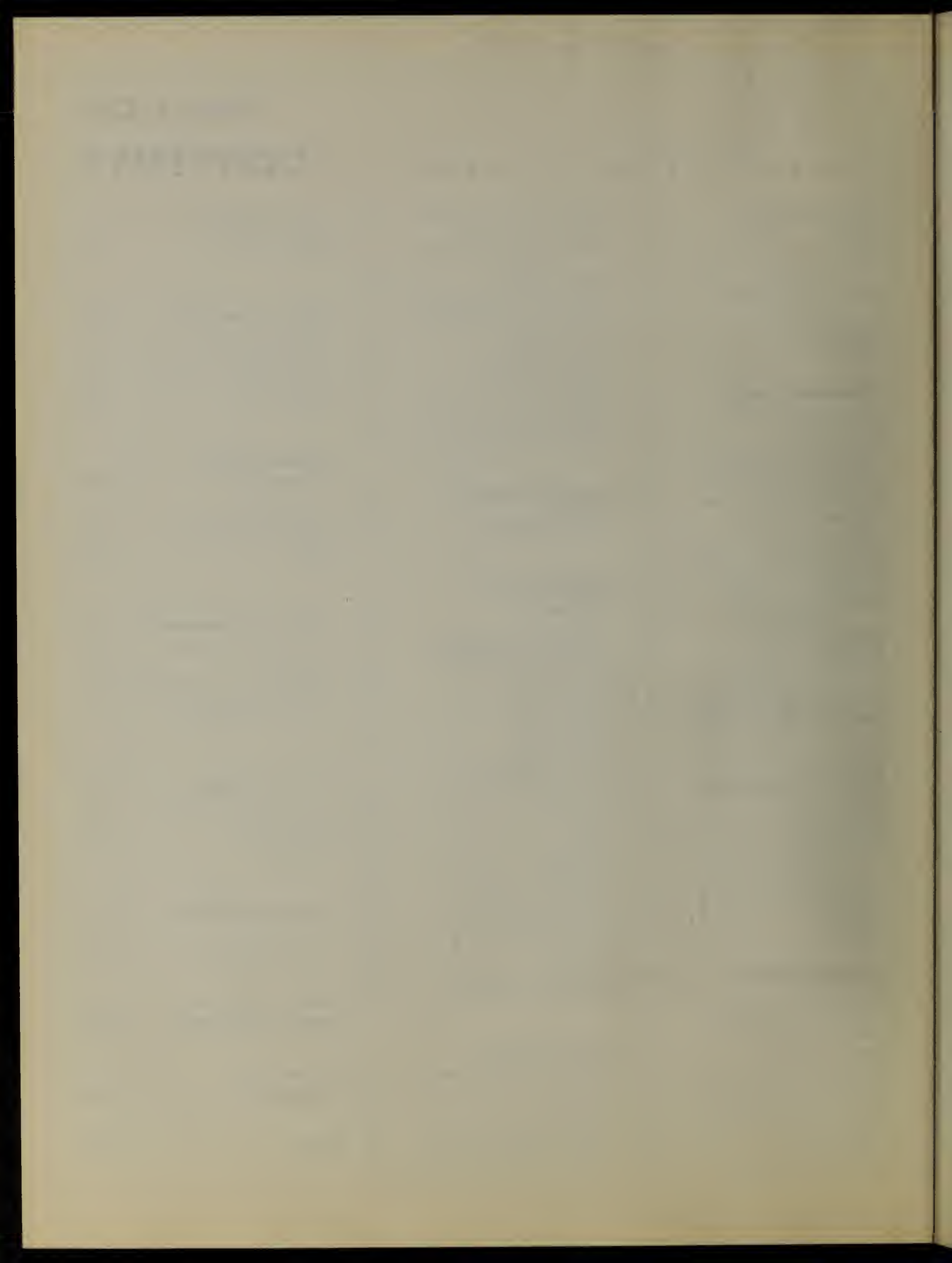


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UNIVERSITY PROFILE



On July 11, 1991, in a ceremony on the front steps of Cumnock Hall, Governor William Weld signed into law a new University of Massachusetts. The University of Lowell became the University of Massachusetts Lowell. The University of Massachusetts, with campuses at Amherst, Boston, Dartmouth, Lowell, and Worcester is governed by the Board of Trustees through the Office of the President, which is based in Boston. Leadership of the Lowell campus is vested in the Office of the Chancellor. The University of Lowell was established by Chapter 1175, Acts of 1973, General Laws of the Commonwealth of Massachusetts, through a merger of Lowell State College and Lowell Technological Institute. Chapter 1175 directs the University to "provide, without discrimination, educational programs, research, extension, and continuing education services in the liberal arts, in engineering and the sciences, and in the professions." It also authorizes the University to "offer the adult education services of the university extension program" and it confers "general authority to award any earned doctoral degrees" with the approval of the Massachusetts Higher Education Coordinating Council.

College of Education

The College of Education offers graduate programs only. The offices of the dean and the faculty of the College of Education, as well as all education classes, are located on the West Campus. The College of Education offers elementary and secondary teacher certification in conjunction with master of education degree programs. Certificate of advanced graduate study and doctor of education degree programs are also offered. Students who are interested in teaching or other careers in education should address their inquiries directly to the office of the dean. The College includes: the Center for Field Services and Studies, which develops collaborative programs with elementary and secondary schools, operates a two-way television network and recruits undergraduates to serve as volunteers in K-12 schools; the Demonstration School, a partnership with the Lowell Public Schools, which fosters bilingual language development for children beginning at age three years; the Tsongas Industrial History Center, which offers hands-on learning of history, science and technology and is operated in collaboration with the Lowell National Historic Park at the Boot Mills; and the Economic Education Center which provides resources to teachers in order to promote an understanding of economics in the elementary and secondary schools.

James B. Francis College of Engineering

The College of Engineering is housed in the following facilities on the North Campus: Ball Hall, Engineering Building, Falmouth Hall, Kitson Hall, Pasteur Hall, and Southwick Hall. The offices of the Departments of Electrical, Mechanical and Energy, and Plastics Engineering are located in Ball Hall. The Department of Chemical Engineering is located in the Engineering Building. Civil Engineering is in Falmouth Hall. Offices of the dean and assistant dean are in Kitson Hall.

College of Fine Arts

The College of Fine Arts is located on the South Campus. Art instruction is housed within Coburn Hall, Dugan Hall, and the McGauvran Student Center. A new graphic design center is located in the nearby Wannalancit Mill building.

Exhibition spaces include Gallery 410 in McGauvran Center and student exhibition galleries are located in O'Leary Library and on the lower floor of Dugan Hall. All music instruction is housed within Cyrus Durgin Hall which features Durgin Concert Hall, Fisher Recital Hall, sound recording technology studios, a computer laboratory, rehearsal halls, classrooms, practice facilities, and studios.

College of Health Professions

The College of Health Professions is located in Weed Hall (South Campus), which houses the offices of the dean and the chairs of the Department of Clinical Laboratory Sciences, the Department of Health Education and Administration, the Department of Nursing, and the Department of Physical Therapy. Special classrooms, laboratory facilities and a student lounge are also located in Weed Hall.

Facilities in the college include a variety of fully equipped state-of-the-art laboratories, an audiovisual laboratory, a computer laboratory, an interactive video lab and anatomy and physiology laboratories. Simulated clinical laboratories are available in the areas of chemistry, hematology, microbiology, and immunohematology. The Department of Nursing provides three simulated laboratories with the most modern nursing and life support equipment. Its audiovisual laboratory is equipped for self-paced instruction in basic and advanced nursing skills. Laboratories of the Exercise Physiology major are supplied with state-of-the-art equipment. Computer laboratories, containing microcomputers and several terminals which are connected to the University's main-frame computer, are available for assisted instruction and simulation for each department in the college. The majority of clinical experiences for medical technology, health education, nursing, and exercise physiology programs are conducted in public schools, health agencies, corporations and hospitals of the region.

College of Management

The College of Management is located in the North Campus quadrangle in Pasteur, Falmouth and Southwick Halls. The administrative offices of the College and its Center for Industrial Competitiveness are

located on the third floor of Pasteur Hall. The College's student microcomputer lab, equipped with the latest technology, is in Pasteur 205. Departmental offices are located in Pasteur 213 (Accounting), Southwick 301 (Management and Policy and Planning Department) and Falmouth 205 (Manufacturing/Management Information Systems Department).

University College

University College, formed in 1994, includes: the Centers for Teaching and Learning, the Division of Continuing Education, and Freshman Programs.

The purpose of University College is to enable students to develop their educational and professional credentials at a flexible pace in day or evening programs throughout their lifetimes. Experienced faculty and professional advisors consult with students to create educational plans that maximize the opportunities and support services available at UMass Lowell. In addition to personalized support services for students, the College enables the faculty to incubate interactive teaching strategies, uses of technology in the classroom and new courses, degree and certificate programs. Building on its expertise in delivering education to off campus customers, the University is now seeking new partners to enhance our region's prosperity.

Continuing Education and Summer School

University College's Division of Continuing Education, with over 20,000 credit course enrollments annually in a variety of educational programs, offers twenty-nine degree programs at both the associate and baccalaureate levels, nineteen certificate programs, and credit courses for part-time, non-matriculating students. Undergraduate courses are offered not only in the fall and spring semesters, but during an intensive three-week Winter Intersession as well as two six-week summer terms (both day and evening). The Division of Continuing Education also offers Summer Graduate courses and a Summer Writing Program.

In addition, the Division sponsors Community Education offerings which

Academic Services

include courses for adults whose interests range from personal enrichment to professional advancement.

The Professional Institutes Program designed for people seeking recertification or career updating features such specialized offerings as: PC User Institute, Multimedia User Institute, Entrepreneurship Institute, Health Care Institute, Teacher Recertification, and Executive Development seminars.

The Office of Special Programs manages over 150 professional development seminars and conferences, frequently showcasing University of Massachusetts Lowell faculty and departments.

At present, Continuing Education courses are offered on the main campus in Lowell, the Mogan Center, the Woods Hole Oceanographic Institute, and various on-site business locations. Brochures listing all credit course offerings are available approximately six weeks prior to each semester's opening date. The administrative offices of the Division of Continuing Education are located in Southwick 307.

Graduate School

The Graduate School offers extensive professional and research programs at both master's and doctoral levels. Master's programs are offered in 53 areas. Combined B.A./M.A. and B.S./M.S. degree programs are also available to outstanding undergraduate students in biological sciences, chemical and energy engineering, civil engineering, criminal justice, electrical engineering, industrial technology/work environment, mathematics, mechanical engineering, plastics engineering, psychology, and radiological sciences. The College of Education offers Master's programs in educational administration, curriculum and instruction with options in Bilingual and ESL education, and reading and language (M.Ed.) Doctoral programs are offered in science and mathematics education, leadership in schooling, and language arts and literacy (Ed.D.), electrical, mechanical, and plastics engineering (Eng.D.); in computer science and work environment (Sc.D.); and in chemistry and physics (Ph.D.). The Certificate of Advanced Graduate Study is offered in reading and language, curriculum and instruction, and educational administra-

tion, planning and policy. Many courses are offered in the late afternoon and evening, and most programs can be completed on a part-time basis. Offices of the Graduate School are located in Falmouth 311.

Combined Bachelor's/Master's Degree

The UMass Lowell Graduate School offers a unique opportunity to combine a bachelor's degree with a graduate program and obtain a master's degree after one additional year of study. Upon graduation from the university, students with the combined bachelor's/master's degree often find they have a distinct advantage in the competitive job market. Highlights of the program include: 1) students with a 3.0 or greater grade point average are eligible to apply; 2) an application must be submitted in the junior year; 3) no Graduate Record Exam (GRE) is required; 4) up to 12 credits of graduate work above the university minimum of 120 credit requirement can be used for both the bachelor's and master's degree; 5) after students earn the bachelor's degree, they are eligible for teaching or research assistantships to help pay for the cost of graduate education.

Departments participating in the Bachelor's/Master's program: Biological Sciences, Chemical & Energy Engineering, Civil Engineering, Clinical Laboratory Sciences, Computer Science, Criminal Justice, Electrical Engineering, Psychology, Mathematics, Mechanical Engineering, Plastics Engineering, Radiological Sciences, Work Environment. The Bachelor's/Master's in Education* is offered in these areas: Biological Sciences, Chemistry, English, Earth Science, History, Mathematics, Physics. [*College of Education has additional standardized test requirements.]

To request an application: 800-656-GRAD, 508-934-2380, gradschl@woods.uml.edu,

<http://www.uml.edu/grad>, or stop by the Graduate School Office at Falmouth 311. The complete Graduate School catalog with detailed degree program descriptions is located at the web site.

Academic Services

Academic services include the Academic Computer Center, the Centers for

Learning and Academic Support Services (CLASS), the Honors Program, the College Consortium for International Studies, the University libraries, and the Research Foundation.

Academic Computer Center

The University of Massachusetts Lowell provides a large, sophisticated computer network in which 2500 terminals, microcomputers and workstations are linked to more than 150 multiuser computer systems via a campus-wide communications network based on both Ethernet and FDDI, supporting all the major protocols. An integrated voice/data switch allows substantial expansion of this data capacity to all segments of the university population. It is the policy of the University to issue computer accounts to all University students. Public access clusters of terminals, microcomputers and workstations are distributed around the campus.

We maintain large separate central facilities for general purpose academic and administrative operations. These systems consist of clusters of DEC VAX 6420s, 8700s and 8800s running the VMS operating system and support over 600 concurrent terminal sessions. The systems provide access to a comprehensive selection of modern compilers, editors, data base systems, libraries (SPSS, IMSL, NAG, etc.), software development tools and commercial grade application packages (SDRC IDEAS packages, DEC software library, SPICE, ANSYS, FEAP, MOLD-FLOW, etc.). The university library system is fully computerized and accessible via the campus network. We are active participants in CSnet, BITnet and several other computer networks.

These central systems also support university-wide electronic mail, electronic conferencing and videotext capabilities; access to high speed, high quality laser output is also available via this cluster. The University has recently undertaken the replacement of its word processing systems with microcomputers that are linked to the academic cluster for document exchange and file storage.

Dedicated computing facilities are also distributed throughout the colleges and academic departments. The heaviest concentrations of dedicated terminals,

workstations and super minicomputer systems are installed in the Engineering and Computer Science areas. Engineering resources include: file and compute services provided by a VAX cluster (6310 and 6510 systems), DS 5100 ULTRIX server, several microVaxs and a Data General AViiON supporting over 150 graphics terminals and workstations. Special purpose systems include: an HP 1000 for real-time structural analysis, VAX 8530 and Vaxstations for VLSI and semiconductor design, ALLIANT FX/80 and FX 8 for computational fluid dynamics and several Concurrent systems for real time applications.

Support for the Computer Science Department's research and academic programs includes: DEC VAXs (8550, 8350s, microVaxs), Data General MV 7800 and AViiON RISC systems), Sequent Balance 21000, Intel Hypercube, DEC RISC systems and a number of special purpose smaller systems. All major systems and some 90 workstations are interconnected by several LANs and the University broadband network.

Each of the other Colleges have their own dedicated facilities to supplement the central computer center. We have experienced an explosive growth in the demand for and access to microcomputers (count exceeds 1500). A network of over 300 workstations (DEC, HP/Apollo, SUN, DG and IBM) support design, software development and analysis needs. Very high performance graphics mini super-computers from Stardent, Apollo and PIXAR are available as distributed resources for large compute and graphics intensive tasks.

Centers for Learning and Academic Support Services

The purpose of this department is to provide support services to students to optimize their academic performance and to foster the development of innovative instructional strategies. Services are provided through the Centers for Learning and Academic Support Services (CLASS) and are comprised of three program components: Educational Computing, Tutoring and Educational Planning, and the Freshman Year Program.

Educational Computing

The Educational Computing program hosts four computer labs that provide easy access to users and feature a wide variety of MS-DOS, VAX and Macintosh computers and a multimedia workstation. Drop-in users consult with technical assistants to learn about the latest innovations in hardware and software applications. Students can obtain assistance in developing papers and projects for courses. The faculty work with staff to develop applications of computer technology for instructional purposes. The labs maintain an extensive library of software that includes programming and statistical packages, graphics and desktop publishing, word processing and a host of tutorial software.

The Tutoring Program

The Tutoring Program strives to promote academic success by having highly qualified undergraduates tutor their peers. Tutors work with students collaboratively in both small group and individual sessions to enhance student performance in over thirty subjects. Students who feel that they are not adequately prepared for their courses or who are having difficulty understanding particular concepts may drop-in to work with a tutor in that subject. Tutors work with students to deepen their understanding of course material by reviewing problems and concepts and by allowing the student to proceed at his/her own pace. Some students 'check-in' with tutors to clarify a small question, while others work with the tutors on an ongoing basis. Tutoring is available in many required freshman and sophomore subjects such as College Writing, mathematics and sciences, and management. Students hired as tutors are recommended by faculty, complete an orientation program and participate in monthly staff training. Tutoring schedules are available each semester.

Educational Planning Office

The goal of the Educational Planning Office is to enable students to assess their own abilities and talents while exploring the full range of educational opportunities at University of Massachusetts Lowell. A drop-in center has been established where students can access information regarding career goals and related academic programs and requirements. An advising

handbook, which features up-to-date information on major and minor requirements and University policies and procedures, is available for students and faculty. Financial planning information and study skills workshops are also available through this office.

The Freshman Year Program

The goal of the Freshman Year Program is to enhance the freshman experience by facilitating the successful transition from high school to college. To accomplish this, the program works closely with the faculty and staff to provide on-going orientation regarding innovative learning strategies. There are two components to this program: Strategies for Success and Project Restart.

Strategies for Success

A series of innovative orientation programs and publications targeted to freshman survival. The purpose of these programs is to provide freshmen with timely and meaningful information about survival skills, learning strategies, and University policies and procedures.

Transitional Programs

University College Transitional Programs serve as pathways to all undergraduate majors and are designed for students who are undecided or who prefer a program of study that emphasizes individualized academic assistance. For adult learners, University College serves to ease the transition into college. Candidates whose potential and motivation for higher education indicate an acceptable probability of academic success are accepted into University College. To be considered, applicants must follow the regular application procedures for day school programs.

The Honors Program

The Honors Program has been established "to provide enriched academic opportunities to meet the educational needs of exceptionally talented students and to foster the pursuit of scholarly excellence in undergraduate higher education. By fostering interactions among outstanding, motivated students and outstanding, dedi-



Academic Services

cated faculty, the Honors Program is directed toward the recruitment, development, guidance, retention and professional growth of gifted students in activities designed to enhance their critical, cognitive and creative potential." The Program is conducted through a 20-member Honors Council, composed of administration, faculty and staff representatives and chaired by the Dean of University College. It is in overall charge of an Honors Director with two Associate Honors Directors. The University requires that freshman honors students meet two out of four conditions: 1) They must have a combined SAT score of 1200 or better (or ACT score of 26 or better); 2) they must have graduated in the top 15 percent of their high school class;

3) they must provide at least two written recommendations from principals, high-school counselors or senior teachers; and 4) they meet special circumstances. Transfer into the Honors Program is also permitted up to the first semester of the junior year. To graduate with an Honors Diploma as well as their academic Degree, students must have obtained at least 24 credits in Honors courses and maintained a cumulative GPA of 3.25 or better. Regular students who are not members of the Honor Program may also participate in honors courses. Such honors courses are provided in three forms: (i) Designated Honors Courses;

(ii) Honors Sections of regular courses, and (iii) Contract Honors for individual students desiring to take a given course at an elevated level. A thriving Freshman Honor Society, affiliated with Alpha Lambda Delta, inducts students who have obtained a grade-point average of 3.5 or better in their first year of study. The Program emphasizes a personalized approach to small classes and aims to bring out the very best in students who strive for the highest accomplishments.

The College Consortium for International Studies

The College Consortium for International Studies, a partnership of colleges and universities - two - and four-year, large and small, public and private, domestic and foreign - encompasses the broad spectrum of international higher education. Through its member, CCIS sponsors a

variety of programs notably study abroad programs and professional development seminars for faculty and administrators, which are designed to enhance international/intercultural perspectives within the academic community. Recognizing the value of such experiences in fostering global understanding and peaceful cooperation among nations in an increasingly interdependent and rapidly changing world, CCIS is committed to developing international dimensions as an integral part of collegiate education. CCIS works to build collaborative arrangements among institutions who share this commitment, and to facilitate linkages between member institutions and international partners. In all of its program and activities, CCIS strives for a high level of academic excellence.

Study Abroad Programs

Thirty-five programs (semester, academic year, and short-term) in twenty-one countries worldwide: Bulgaria, Canada, China, Colombia, Costa Rica, Cyprus, Ecuador, England, France, Germany, Greece, Ireland, Israel, Italy, Jamaica, Japan, Mexico, Portugal, Russia, Spain, and Switzerland.

Twenty summer programs in fourteen countries worldwide: Bulgaria, Canada, Cyprus, Costa Rica, Ecuador, England, France, Germany, Greece, Israel, Italy, Portugal, Russia, and Spain.

The Consortium also provides Internships/ Work-Study Programs in: Bulgaria, Cyprus, Ecuador, England, France, Germany, Israel, Italy, Jamaica, and Russia.

University Libraries

The University library system consists of facilities at four locations. The O'Leary Library, located on the South campus, concentrates on resources in education, music, health, the humanities and social sciences; Lydon Library, situated on North Campus, has resources focused on sciences, technology and management. The Instructional Resource Center on West Campus supports such College of Education programs as mathematics and science, curriculum design and initial certification. The Center for Lowell History

at the Mogan Center in downtown Lowell contains a variety of manuscripts, books, and photographic and oral history, materials on Lowell, the textile industry, immigrants, the Boston and Main Railroads, and other special collections.

Present library holdings include over 400,000 volumes; 625,000 micro form items; 2,900 videos; 8,600 music scores; 6,000 sound recordings; 3,500 videotapes; 360,000 government documents; and 3,700 current periodical subscriptions. The fully automated library catalog of holdings can be accessed at any of the libraries; at terminals throughout the University via the campus network; and remotely via dial-up ports. The library provides direct access to the on-line catalogs of major research libraries throughout the United States, electronic interlibrary loan processing through OCLC and remote database searching through Dialog and STN. The Library offers computerized end-user search and full text retrieval from over 85 CD-ROM and internet accessible databases.

The library offers services in search strategy development, ready reference, tailored bibliographies of library holdings, general library tours and specialized library instruction for individuals and classes. Media services include individual, class, and large group viewing facilities for video and multi-media programs; consultation on individual media projects, and production of visual, audio and multi-media materials.

Career Services

The Career Services staff assists students develop the skills and understanding needed to make informed choices during their career life. Career development workshop topics include: resume creation, cover letter writing, interview skills and job search strategies. Individual career counseling appointments are available to assist students with specialized concerns.

A comprehensive library of electronic and printed resources is provided for job market research and skills development. Students are able to use several office computers with internet access and one with Career Search, a database product that expedites employer identification. Links

to recruiting employers and job search engines are easily found on the Career Services website: <http://ocs.uml.edu>. Additional material includes company information binders, videos and literature for over 2000 companies.

The Recruiting Employers Program is designed to assist students learn about employers and the job market. Binders of current job listings are categorized by functional areas of interest and by industries. Specialized job fairs and career events are organized and hosted on-campus. On-campus recruiting interviews are carried out by over 200 employers throughout the academic year. Off-campus recruiting interviews are generated through the electronic mailing and faxing of student and alumni resumes.

The University Career Advisory Network (UCAN @ Lowell) is a database of professionals and alumni who have volunteered to act as information resources. These individuals have agreed to talk with students and alumni about their career interests and networking sources.

Career Services & Career Related Experiences

The Career Services office provides a centralized operation for students to explore cooperative education and internship opportunities. All postings are organized and maintained in a system of binders and directories. Cooperative Education opportunities for Engineering and Computer Science can also be found on the Career Services' website.

The College of Engineering, in cooperation with Career Services, offers an optional, academic credit bearing Cooperative Education program. In order to participate, students must: complete their freshman year and at least one full academic semester at UML; maintain good academic standing; and obtain the approval of their department's faculty co-op advisor.

Additional academic disciplines offer the possibility of experiential education through internships, field experience, clinical rotations or cooperative education. Some of these many areas include: Computer Science, Accounting, Marketing, Political Science, Health Professions, Education and Music. Please review the policies and requirements of your area of study.

Office of Student Services

Cumnock Hall X2100

Ellen C. Duggan, Associate Dean of Students

Thomas C. Taylor, Assistant Dean of Students

This office provides leadership in the development of services, programs, and activities that enrich the college experience and contribute to an environment that encourages personal growth. In addition, the Deans serve as liaisons to other administrative offices, the college administration, and the faculty. The office serves as a clearinghouse for information which affects students, and it is a good "first stop" for any student looking for answers. More specific services include the following:

- Academic advising advocacy
- Commencement ushers
- Emergency student loans (\$50 for 30 days)
- Faculty notification of student absences (1 week or more)
- ID card operations
- Inter-Campus transportation (Shuttle busses)
- Judicial and Conduct Code Procedures
- New student orientation programs
- Religious Life programming
- Specialized issue and Program committees

There are seven divisions within Student Services providing a wide variety of services to students. These offices are noted below and students are encouraged to contact them should they need additional information and/or have questions:

The Office of Residence Life - Cumnock Hall

Larry Siegel, Director 934-2107

The Office of Student Activities, Commuter Services & Student Centers McGauvran 224

Mary Connelly, Director 934-5001

The Counseling Center - McGauvran

Dr. Noel Cartwright, Director 934-4331

The Office of Student Health Services - Standish Street

Nancy Quattrocchi, Director 934-4991

The Career Services Office - Southwick Hall

Pat Yates, Director 934-2352

The Office of Disability Services - Cumnock Hall

Elizabeth Donaghey, Director 934-2114

ALANA Student Center, McGauvran 335

Dr. Lanett Scott, Director 934-4336

Research Foundation

For additional information, contact Louis J. Petrovic, Director, External Funding, Technology Transfer, and Partnering, University of Massachusetts Lowell Research Foundation, 600 Suffolk Street, Second Floor South, Lowell, MA 01854; Telephone: 508-453-6586; E-mail: Petrovicl@woods.uml.edu

Athletics

Umass Lowell men's and women's intercollegiate athletic teams are highly regarded throughout New England and the nation.

Five Umass Lowell teams have captured NCAA team championships, while seven student-athletes have won NCAA individual titles. Since 1975, Umass Lowell student-athletes have earned 140 All-American citations.

Umass Lowell offers 22 intercollegiate varsity sports. The men's ice hockey team competes at the Division I level, and all other sports compete at the NCAA Division II level.

Varsity Programs:

Fall

Cross Country (M&W), Field Hockey (W), Football (M), Soccer (M&W), Tennis (W), Volleyball (W)

Winter

Basketball (M&W), Ice Hockey (M), Indoor Track (M&W), Swimming (M), Wrestling (M)

Spring

Baseball (M), Crew (M&W), Golf (M), Outdoor Track (M&W), Softball (W), Tennis (M)

Recreational Sports

For students who seek athletic opportunities outside of our varsity program, we offer over 30 intramural sports, ranging from the traditional to the innovative; sports clubs that provide instruction and competition against other institutions; and high quality, low cost fitness instruction.

ADMISSIONS POLICIES



The following pages describe in detail University requirements and processes concerning the admission of high school graduates, non-traditional students, and transfer students; the admission of international students and candidates for second degrees; the admission of non-matriculating students; and the readmission of previously enrolled University students. These pages also provide basic information concerning degree programs, applicant inquiries, application deadlines, advanced placement, health certification requirements, and the Commonwealth Transfer Compact.

Admission General Policies

Admission to all baccalaureate day programs is made through the Office of Admissions and according to established undergraduate policies. Admission to programs of continuing education or to summer school, which is made through the Division of Continuing Education, does not constitute admission to baccalaureate day programs and implies no commitment, per se, for subsequent application of continuing education or summer school courses to baccalaureate day programs. It is the policy of the University of Massachusetts Lowell that students seeking admission to either regular or continuing education programs will be evaluated on their merits and (as prescribed in applicable federal and state laws) without respect to their race, color, creed, national origin, age, gender, handicap, sexual orientation, veteran status or marital status. The University makes a special attempt to attract students from various racial backgrounds and disadvantaged environments.

The admission policies of the University of Massachusetts Lowell, which are in keeping with its mission and the guidelines of the Massachusetts Board of Higher Education, specify procedures for admitting three types of applicants for undergraduate degrees:

1) high school seniors and individuals who have graduated from high schools within the past three years; 2) non-traditional students; and 3) transfer students. Accordingly, these policies not only protect the intellectual integrity and strength of the University by requiring standards of preparation and objective evidence of the student's potential for success but also provide access for a diverse student population including traditional and non-traditional students and students with special needs and talents. Individuals who are admitted by the Office of Admissions must be accepted under one of the following categories:

1. as undeclared students (entering as freshmen or transfer students with less than 60 semester credits*) who wish to establish initial matriculation for a degree which is offered by one of the colleges of the University of Massachusetts Lowell;

*Several colleges do not accept undeclared students who transfer more than 30 credits. Such students are required to declare majors if applying to such colleges.

2. as declared students (entering as freshmen or transfer students) who wish to establish initial matriculation for a Lowell degree and who have a commitment to an academic major or professional program which is offered by one of the colleges of the University;
3. as provisional students of University College;
4. as declared students with advanced standing who wish to pursue a second baccalaureate degree at Lowell after having completed an initial baccalaureate degree at the University or other accredited institution; or
5. as non-matriculating students admitted on a semester-by-semester basis under provisions governing special plans for non-degree studies which are designated at the time of admission.

To be admitted for undergraduate study, applicants must present records of academic performance which indicate a reasonable probability of success in their chosen programs or colleges. For regular freshman admission to an undergraduate college or degree program, probability of success is measured by an individual's high school record, class standing, and standardized test results. For regular transfer admission to an undergraduate college or degree program, probability of success is measured by an individual's previous academic record at some other accredited institution of higher education. Within the space available in particular programs, admissions are offered first to those whose performance record indicates the highest probability of success in the chosen college and/or program. Specific academic standards requirements are described below under headings for admission categories.

The University welcomes correspondence from prospective students who may need assistance in adapting their high school programs to satisfy specific program requirements. Such correspondence should be addressed to the Office of Admissions, University of Massachusetts Lowell, Lowell, Massachusetts 01854. Requests for application forms should be directed to the same office.

Applicant Decisions Concerning Program Selection

Entering freshmen who prefer to test their abilities and interests or who wish to explore several areas of study before identifying themselves with one of the baccalaureate day programs can request admission as undeclared students. Students transferring with 60 or more credits may not request status as undeclared students and must enter the University with a commitment to an academic major or professional program. Enrollments in certain professional programs are limited. Undeclared students are advised that openings in a desired professional program may be inadequate to accommodate all qualified undeclared student applicants at the time when program declarations must be made (upon completion of 45 credits). When resources of a college or program render it necessary to establish admission quotas, differential admission criteria above and beyond specified admission requirements will be applied in the selection of applicants as matriculating students.

Depending upon enrollment restrictions, application deadlines vary for some programs may be offered waiting list status. An applicant who has been approved for admission to restricted programs will be advised in his or her letter of the specific deadline for accepting an offer of admission and for making a required tuition deposit. For all other baccalaureate programs, the University operates on a rolling admission plan.

To confirm an offer of University admission, an applicant who has been approved for admission to any program other than those which are specified as having enrollment restrictions must make a required tuition deposit within fifteen days of the date on his or her official acceptance letter. A refund of the tuition deposit will be made to individuals who notify the Office of Admissions in writing by May 15th that they wish to cancel their University admission. A refund of the tuition deposit will not be made after May 15th.

Baccalaureate degree programs are offered by the Colleges of Arts and Sciences, Engineering, Fine Arts, Health Professions, and Management. Continuing education degree programs at both the associate and baccalaureate degree levels are offered in the evening. Applicants who wish to apply for continuing education programs should address their inquiries to the Office of Continuing Education, Southwick Hall,

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North Campus. Teacher-preparation programs are offered at the graduate level.

Programs

College of Arts and Sciences

American Studies
Biological Sciences
Biotechnology Option
Chemistry
Computer Science
Criminal Justice
Economics
English
Environmental Science
Environmental Studies Option
Geoscience Option
Atmospheric Science Option
History
Liberal Arts
Mathematics
Applied Mathematics Option
Scientific Computing Option
Statistics & Operations Research Option
Modern Languages
Philosophy
Communications & Critical Thinking Option
Political Science
Psychology
Sociology
Physics
Radiological Health Physics Option
Optics Option

College of Engineering

Civil Engineering
Electrical Engineering
Mechanical Engineering
Chemical Engineering
Plastics Engineering

College of Fine Arts

Music
Fine Arts
Graphic Design
Music Education
Performance
Music Business
Sound Recording Technology

College of Health Professions

Clinical Laboratory Sciences
Medical Technology option
Exercise Physiology
Health Education
Nursing

College of Management

Business Administration
with concentrations in:
Accounting
Finance
Management
Manufacturing Information Systems
Marketing
Industrial Management

Change of Baccalaureate Program Declaration After Application

Individuals who are admitted to specific programs or to a college with an undeclared student status and who wish to change their designations of program or college admission may do so by notifying the Office of Admissions no later than one month prior to the date established for freshman registration. Changes will be approved only if space in the desired program or college permits and the applicant has satisfied all admission requirements for the newly designated college or program. Changes in program designation can be made after registration by filing requests for change of major and/or inter-collegiate transfer within the University.

Admission Policies for Traditional Students

Graduating High School Seniors and High School Graduates

Graduating high school seniors and high school graduates who wish to be admitted to the University as matriculating students must comply with the following:

1. file an official application form with the University of Massachusetts Lowell prior to April 1;
2. request high school principals or guidance directors to forward to the Office of Admissions transcripts of secondary school grades—including grade reports for at least the first quarter of the senior year;
3. arrange to take the College Entrance Examination Board Scholastic Aptitude Tests.

Detailed information concerning the College Entrance Examination Board tests

and the dates throughout the year on which they are administered may be secured from the Office of Admissions of the University of Massachusetts Lowell, high school principals or guidance directors, or the Educational Testing Service, Princeton, New Jersey 08540. Special information is provided in the following sections concerning required aptitude examinations for applicants to music programs and for satisfaction of department language requirements through the Foreign Language Achievement Tests of the College Entrance Examination Board.

Following receipt of application forms, transcripts of high school records, and Scholastic Aptitude Test scores, the Office of Admissions may arrange appointments for personal interviews of applicants. The responsibility for having all credentials forwarded to the University of Massachusetts Lowell rests solely with the applicant.

Admission Requirements for Graduating High School Seniors and High School Graduates

The general expectation is that applicants will present course work which has been taken within college preparatory curricula. However, the Office of Admissions will evaluate the academic units of vocational technical school (Chapter 74) graduates to determine their relevance for University curricula. The ultimate judgment concerning such equivalency rests solely with the University of Massachusetts Lowell. The following pages specify prescribed high school unit requirements which will be imposed over the next three years and other qualitative requirements for the admission of freshmen students. Applicants must satisfactorily complete prescribed units prior to enrollment. Table I specifies the high school unit distribution which is required for general University admission. An applicant who has a minor academic unit deficiency may be provisionally accepted for college admission pending correction of deficiency in summer school.

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Prescribed High School Unit Requirements

General University Admission

Subject	Units Required
• English	4 courses
• Mathematics	3 courses (Algebra I & II and Geometry or Trigonometry, or comparable coursework)
• Sciences	3 courses (including 2 courses with laboratory work)
• Social Sciences	2 courses (including 1 course in U.S. History)
• Foreign Languages	2 courses (in a single language)
• Electives	2 courses (from the above subjects or from the Arts and Humanities or Computer Sciences)
Total Prescribed Units	16

Qualitative Requirements for the Admission of Freshman Students

Graduating high school seniors (including applicants graduated from secondary schools within the last three years) who seek freshman admission as matriculating students must comply with the following:

An applicant must present a high school GPA of 2.75 (3.0 for students entering Fall 1998) or above in all college preparatory courses, as calculated at the end of the seventh semester on a weighted scale (with consideration of honors courses and advanced placement courses).

If a student's GPA falls below the minimum required, the following sliding scale will apply. This scale should be used only when a student's GPA falls below the 2.75 minimum.

GPA	SAT must Equal or Exceed	ACT must Equal or Exceed
2.51-2.99	890	19
2.41-2.50	930	20
2.31-2.40	970	21
2.21-2.30	1010	22
2.11-2.20	1050	23
2.01-2.10	1090	24
2.00	1130	25

Note: SAT test scores are re-centered scores.

Students who meet the minimum GPA requirement must submit SAT or ACT tests scores if they are applying to UMass Lowell within three years of high school graduation. These test scores may be used in determining eligibility for specific majors.

*SAT Requirements

College of Arts and Sciences Humanities and Social Sciences

Verbal 450 Math 450 Comb 900

Math and Sciences

Verbal 500 Math 500 Comb 1000

College of Engineering

Verbal 500 Math 500 Comb 1000

College of Fine Arts

Verbal 450 Math 450 Comb 900

College of Health Professions

Verbal 500 Math 500 Comb 1000

College of Management

Verbal 500 Math 500 Comb 1000

**SAT requirements may be higher for specialized programs.*

Music Aptitude and Proficiency Examinations

College of Fine Arts

Students who wish to apply for music programs are required to demonstrate vocal or instrumental ability in a performance audition with a member of the faculty of the College of Fine Arts. The student is also required to achieve satisfactory scores on both a written test of music fundamentals and a brief examination in aural comprehension. Performance auditions and theory testing are scheduled throughout the academic year. Applicants will be invited to take these special music tests at the University when all credentials have been approved by the Office of Admissions.

Application Procedures for International Students

Applicants who are residents of international countries are required to supply the Office of Admissions with SAT scores, secondary school and/or college records, as well as all other application materials, submitted in English. All international students must file the financial resource form, Certification of Finances, which evidences sufficient financial resources for their years of study at the University.

Applicants must have considerable facility

in speaking and writing English, and prospective students whose native language is not English are required to take the Test of English as a Foreign Language (TOEFL). A score of 500 or above is required by the University. Students are responsible for making arrangements for taking this test and should address inquiries to: TOEFL, Educational Testing Service, Princeton, New Jersey 08540, U.S.A. The completed application form should be returned to the Testing Service at Princeton well in advance of the application deadline. The test fee, which should be remitted with the application, entitles the student to have his test score sent to three different institutions. Registration for the Test of English as a Foreign Language does not constitute application for admission to the University of Massachusetts Lowell. The bulletin of information, obtainable without charge, contains a description of the test as well as rules regarding application, fees, reports and the conduct of the test; lists of examination centers and examination dates; and an application blank. On the application for the test, the student should specify that his score be sent to the Office of Admissions, University of Massachusetts Lowell, Lowell, Massachusetts 01854. In addition to the TOEFL, an admitted student may be required to report to the Office of Admissions to make arrangements for taking an English placement test for foreign students prior to registration. Results of this test may determine the courses for which the student will be permitted to register in his or her program of study.

Application Procedures and Requirements for Non-Graduates of High Schools

Individuals who have not graduated from high school may be admitted to the University upon satisfactory completion of the General Educational Development tests and receipt of a certificate of high school equivalency. Such students are required to take the Scholastic Aptitude Tests of the College Entrance Examination Board prior to their application and to present scores which are acceptable to the University. Admissions procedures for students possessing certificates of high school equivalency are the same as those which are prescribed for graduating seniors and high school graduates.

*General Policies***Admission Policies for Non-Traditional Students**

Non-traditional students who seek admission as baccalaureate degree candidates may seek admission to the University through three programs: 1) the full-time Educational Opportunities Program for under-represented students, 2) the part-time Encore Program (three to eleven credits per semester) for adults, 3) full-time in a selected major.

University College Transitional Programs

University College Transitional Programs serve as pathways to all undergraduate majors and are designed for students who prefer a program of study that emphasizes individualized academic assistance. For adult learners, University College serves to ease the transition into college. Candidates whose potential and motivation for higher education indicate an acceptable probability of academic success are accepted into University College. To be considered, applicants must follow the regular application procedures for day school programs.

Admissions Criteria

Admission of first time freshmen into University College will be allowed only in cases when a student's potential for academic success has been clearly demonstrated. Students may have SAT/ACT scores below the UML minimum or may have a high school G.P.A. of less than 2.75. University College recognizes that substantial strength in one academic indicator may allow some flexibility when interpreting a student's overall academic profile.

Admission of transfer students into University College will be allowed for freshmen who have demonstrated college success. To be eligible for admission, a transfer student must possess high school credentials that are equivalent to the standards of admission of first time freshmen to the University.

Low credit students (students who have attempted fewer than 21 credits) who earn a cumulative grade point average of less than 1.7 at UMass Lowell (on academic alert) are eligible to be admitted to University College.

Students who enter the Educational Opportunities Program must meet the definition of educationally disadvantaged and underrepresented students.

English as a Second Language (ESL) students must have minimum score of 500 on the Test of English as a Foreign Language. In cases where a student's language ability is questionable, UML will require an additional measurement of language proficiency administered by UML's ESL Coordinator.

Transitional Programs of Study

Transitional programs of study are developed by the students in consultation with University College advisors. The University College advisors will determine whether the student should be admitted for a 15 or 30 credit transitional program and may require an interview with applicants. The curriculum is individually designed to bring the student into the major of his or her choice by highlighting specific strengths and addressing any weakness. Students who have completed 15 or more semester credits at an accredited college or University (Encore students) within the previous ten years are admitted to pursue a program of transitional studies of 15 semester credits. Students who have completed fewer than 15 credits (transfer students) at an accredited college within the previous ten years, or who have never attended an institution of higher education, are admitted to pursue a program of transitional studies of 30 semester credit requirements.

Program Requirements

Students admitted to University College must sign a contract which stipulates the following program requirements:

All students must fulfill the minimum University competency in mathematics and English. In addition, students will be required to pass Values and Creative Thinking, a course designed to enhance the ability to be successful at the University (Students who have at least two years of life experience beyond high school may place out of this requirement). Students may be required to participate in support services in order to improve their potential for success such as tutoring, counseling, etc.

Academic Standing and Review

At the end of each semester of full-time enrollment (or after 12 attempted credits for part-time students), the record of each University College student is reviewed by the University College advisor. First time and transfer students must be able to

demonstrate satisfactory academic progress in the following areas: GPA of 2.0 or greater, grade of C or better in Values and Creative Thinking, and satisfactory completion of English and math competency by the end of their second semester. Students whose progress is determined to be inadequate by these criteria will be reviewed by University College advisors to evaluate the student's potential to meet those requirements within one semester. If it is determined that the student will be unable to successfully complete the requirements, he or she will be dismissed from University College. Low-credit students who have been placed on academic alert and have chosen University College, must meet the above stated progress criteria within one semester of residency in University College.

Students failing to reach these requirements will be dismissed from University College. Students who fall below standards by not more than 0.1 may appeal to the University College Appeals Board.

Transitional Program Qualifications for Transfer into a Major Department

By the end of their fourth semester or equivalent for part-time enrollment (48 credits), all University College students must petition to matriculate into the major of their choice. Students are required to have met the criteria outlined above, earned 30 credits of CD or better, 15 of which must be of 'C' grade or better and have a G.P.A. of 2.0 in order to make such a petition. Once these program requirements have been met, all D and F grades and credits will be removed from the calculation of the student's cumulative G.P.A. Students unable to meet these requirements by the end of their fourth semester or equivalent for part-time enrollment, will be dismissed from University College.

Students who achieve superior academic standing may petition to matriculate to their intended major earlier in their program of studies upon approval by the Dean of their intended college.

In order to declare a major, students must follow procedures established for intercollegiate transfer. University College advisors will assist students throughout the matriculation process to determine the student's eligibility for acceptance into the department. If acceptable, the department chairperson will review and evaluate a stu-

General Policies

dent's petition and return a signed form of acceptance to the University College advisor. Only then will the student be officially transferred from University College to another college in the University. University College students who have satisfactorily completed their transitional programs and who wish to continue their studies on a part-time basis are permitted to do so in many undergraduate programs of the University. However, individuals should understand that openings may be limited or unavailable in some programs and that some programs have established admission requirements which mandate the completion of specific prerequisite courses and/or the achievement of higher grade-point averages than are specified by University retention standards. The University College staff will advise individuals of these requirements when their choice of curriculum has been determined and will assist in the development of a provisional program which is relevant to the curriculum.

Financial Assistance

Students of the University College are eligible to apply for financial aid by filling out the Free Application for Federal Student Aid (FAFSA). Priority is given to students who apply before March 1st but students may apply beyond that time period.

Students in the University College have full access to residence halls, food services and University activities. Participation in varsity athletics will be permitted as long as the student meets NCAA initial eligibility rules and makes satisfactory progress based upon academic standards of the University and the NCAA. Each student will be individually reviewed by the faculty athletic representative or designee.

Transfer Students

Application Procedures and Requirements

In general, the University of Massachusetts Lowell will accept on an hour-for-hour basis semester credits with grades of C- (1.700 on a 4.000 scale) or better as shown on official transcripts of record which are received directly from other accredited collegiate institutions and which are applied to an initial baccalaureate degree.* Quarter credits are recognized on a prorated basis of three quarter credits

to two semester credits. (Students who are interested in transferring credits for an additional baccalaureate degree should consult the appropriate section below concerning such admission.) Preference for admission to the University is based upon the record of each individual transfer applicant at the end of the semester preceding admission. All credits to be transferred must be identified at the time of application for transfer. The University reserves the right to deny credit for course work taken by the student prior to admission if it is identified and presented after transfer.

*No credit will be recognized for the grade of P unless the catalog of the transferring institution specifically states that P is equivalent to a final course grade of C- (1.700 on a 4.000 scale).

Students who transfer from four-year institutions must complete a minimum of 30 semester credits at the University of Massachusetts Lowell to be eligible for a Lowell baccalaureate degree. The University will not reduce the minimum residency requirement of 60 semester credits for students who present 60 or more semester credits from a two-year college. The records of applicants 1) who have completed associate degree programs or who have established matriculation at other accredited institutions of higher education and 2) who are eligible to return to such institutions for the semester in which they seek admission to the University are routinely processed by the Office of Admissions for regular transfer admission.

Required Credentials for Transfer Applicants

It is the responsibility of students seeking transfer to the University to arrange with the institution in which their previous work was completed to forward to the Office of Admissions no later than May 1st for fall semester admission or November 15 for spring semester admission official transcripts of their completed courses and notations of all courses in progress.

Additionally, final transcripts of all completed courses must be forwarded to the Office of Admissions following the completion of previously designated courses in progress. Transfer students whose records are incomplete on the first day of semester classes may be prohibited from attending

courses and may be required to withdraw from the University.

An applicant who has attended one or more institutions must request each registrar to mail directly to the Office of Admissions a transcript of his or her record even though credits were not earned or credits are not presented for transfer.

Transfer students must meet one of the following criteria:

1. 12 or more transferable college credits and a minimum of 2.5 college GPA;
2. 12-23 transferable college credits, a minimum 2.0 college GPA, and a high school transcript that meets the admissions standards for freshmen applicants; or
3. 24 transferable credits and a minimum 2.0 college GPA.

Transfer students who have fewer than 12 transferable college credits must meet the admissions standards for freshmen applicants.

Evaluation of Transfer Credentials

A preliminary evaluation of course credits to be transferred to the University is made by the Office of Admissions at the time of application. Students seeking transfer should be aware that this evaluation by the Office of Admissions is preliminary in nature and that acceptance of transfer credit and assignment of a year of graduation or other status is subject to final review by the student's major department when the student is formally accepted for matriculation by one of the colleges of the University. Credit which is acceptable according to general University standards is not necessarily acceptable for specific programs. This is especially true when program transfer quotas have been imposed. The Office of Admissions will advise applicants when their admission to the University does not guarantee acceptance into their preferred professional programs. The applicability of grades received in transferred courses for the determination of the grade-point average of the student's major at the University of Massachusetts Lowell is determined by policies of each of the colleges.

*General Policies***University Restrictions Concerning Transfer Credit Recognition**

Courses completed at non-public institutions which are not accredited by the major regional accrediting associations will not be credited to degree programs of the University. Nor will credit be granted for courses which are unacceptable to the transfer institution for its own associate or baccalaureate programs or which are completed within post-secondary school diploma programs. Non-credit CEU courses, adult-enrichment or refresher courses, and secondary school correspondence and home study courses also are not recognized for transfer credit. The University reserves the right to refuse recognition for courses which were taken more than ten years prior to the date when a student applies for transfer when, in the opinion of department chairpersons and program directors, the knowledge attained in such courses is deemed to be out of date and/or in need of verification. Competencies which a student has achieved through such courses, or by any other means, may be recognized for credit if verified by CLEP or department examinations.

College and Program Restrictions Concerning Transfer Credit

Many colleges and programs impose additional restrictions on the acceptability of transfer credit. The College of Health Professions and the College of Management have special regulations governing the acceptance of transfer credits for professional courses. Transfer applicants to these colleges should consult the dean of the college or the appropriate department chairperson concerning transfer credit for these courses. The College of Arts and Sciences does not accept in transfer professional courses from any program or curriculum whatsoever with the exception of courses credited to the degree program in the Administration of Criminal Justice. Students transferring to the College of Arts and Sciences may transfer course credits in science and mathematics if these courses are equivalent to those specified by the curricula of the college. Prerequisites for courses in the major field within the College of Arts and Sciences or courses which are prerequisites to admission to the college may not be credited to the minimum degree requirements in mathematics or the sciences.

As a general rule, courses of a professional nature from any curriculum are not accepted in transfer when a student seeks admission to a different curriculum or program at the University of Massachusetts Lowell. Transfer applicants should consult the appropriate dean or departments for current regulations. Additionally, transfer applicants who enter the University in one program, or as undeclared students, may find that certain credits will be deleted from the record when they seek internal transfer to another college or program.

Initial Review of Transfer Students for Compliance with University Retention Standards

For the purpose of determining academic standing, student records are reviewed each semester. Transfer students are initially evaluated for retention purposes at the end of the semester in which they have attempted their first 18 credits at the University unless they have been admitted with probationary status. Transfer students who have been dismissed from their last previously matriculated institution for academic reasons are initially admitted to the University on probation and are reviewed at the end of their probationary semester for compliance with probationary requirements.

Grade-point averages for transfer students are computed solely on the basis of courses attempted at the University of Massachusetts Lowell. Grade-point requirements are based on the total number of attempted course credits. This number includes course credits attempted at both the previous institution and the University of Massachusetts Lowell. For the table of grade-point requirements for specific numbers of attempted course credits, refer to the section "Academic Policies: Determination of Academic Standing."

The Commonwealth Transfer Compact

The University of Massachusetts Lowell has affirmed its intention to maintain flexibility in the transfer of qualified students from community colleges of the Commonwealth of Massachusetts. For the implementation of this objective, the University of Massachusetts Lowell has subscribed to the Commonwealth Transfer Compact and applies to students who apply for admission under this compact

the same policies which are applied to University of Massachusetts Lowell students who petition for intercollegiate transfer within the University.

All courses which have been accepted by the University from signatory community colleges of the Commonwealth Transfer Compact are listed on the student's transcript, and those courses which are not applicable to specific curriculum requirements are credited, whenever possible, as unrestricted elective courses. Since some curricula of the University do not provide for such unrestricted elective courses, or the number of transferred courses may exceed the number of unrestricted elective courses which are permitted within the specifications for minimum degree requirements, transferred courses which are not applicable to the specific requirements of a curriculum are not counted in the determination of the number of course credits completed until the semester of graduation. This procedure prevents the early imposition of a grade point requirement for retention which is in excess of that specified for the number of credits completed and applicable to the student's particular curriculum.

The revised Commonwealth Transfer Compact (1990) provides a process to facilitate the transfer of collegiate credits and to ensure the appropriate recognition of academic progress earned by students at a community college who wish to continue their education at a public college or university.

For Students Transferring from Massachusetts Community Colleges to Public Colleges and Universities Offering the Baccalaureate Degree**Section I. Requirement for Transfer Compact Status**

A student shall be eligible for Transfer Compact status if he or she has met the following requirements:

- a. completed an associate's degree with a minimum of 60 credit hours exclusive of developmental coursework;
- b. achieved a cumulative grade-point average of not less than 2.000 (in a 4.000 system) at the community college awarding the degree; and
- c. completed the following minimum general education core, exclusive of developmental coursework

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English Composition/Writing	6 cr
Behavioral and Social Science	9 cr
Humanities and Fine Arts	9 cr
Natural or Physical Science	8 cr
Mathematics	3 cr

The sending institution is responsible for identifying the transcript of each student who is a candidate for transfer under this compact.

Section II. Credits to be Transferred

The 35 credits in general education specified in Section I will be applied toward the fulfillment of the receiving institution's general education requirements.

A minimum of 25 additional credits will be accepted as transfer credits by the receiving institution. These credits may be transferred as 1) free electives, 2) toward the receiving institutions additional general education requirements, 3) toward the student's major, or 4) any combination, as the receiving institution deems appropriate.

Only college-level course credits consistent with the standards set forth in the Undergraduate Experience recommendations are included under this Compact. Credits awarded by the sending institution through CLEP, challenge examinations, and other life-experience evaluations for course credit may be included when the community college certifies that a student qualifies under this Compact.

Section III. Credits Beyond the Associate Degree

To complete the baccalaureate degree, a student who transfers under this compact may be required to take no more than 68 additional credits unless:

- the student changes his or her program upon entering the receiving institution; or
- the combination of additional general education requirements, if any, and the requirements of the student's major at the receiving institution total more than 68 credits

Under these circumstances, transfer students will be subject to the same requirements as native students. (The term "native student" refers to students who began their undergraduate education at the baccalaureate institution.)

Section IV. Admission to Competitive Majors or Programs

If, because of space or fiscal limitations, the receiving institution does not admit all qualified applicants to a given major or program, the receiving institution will use the same criteria for applicants who are transfer students under this Compact as it does for its native students.

Joint Admissions Program with Massachusetts Community Colleges

The University has joined with the fifteen Massachusetts community colleges to guarantee admission to students upon completion of designated transfer associate's degree programs with a minimum 2.5 cumulative grade point average. Students who elect this option upon enrollment at the community college will receive coordinated advising assistance, periodic communications from University departments, early course registration, financial aid, and campus housing consideration.

Probationary Admission Policy for Transfer Students

Students who have been dismissed for academic or disciplinary reasons from their last previously attended institution may apply for initial admission to the University of Massachusetts Lowell only as probationary students.[#] The respective deadlines for filing such applications with the Office of Admissions are April 1 (for fall semester acceptance) and November 1 (for spring semester acceptance).

[#]This transfer application process may not be invoked by students who have been dismissed from the University of Massachusetts Lowell (cf. "Readmission Procedures for Previously Matriculated Students"). Nor may this process be invoked by students who have been dismissed from the University of Massachusetts Lowell and have subsequently completed either an associate or baccalaureate degree program at another institution.

In addition to the filing of the standard application forms with the Office of Admissions, the applicant for initial admission as a probationary student must comply with the following:

- arrange with all previously attended institutions of higher education to forward copies of all academic records to the Office of Admissions;

- submit a written statement which both explains the nature of the previous dismissal and evidences support for his or her application to the University; and
- file written authorization with the Office of Admissions for release to the University of Massachusetts Lowell of all documentation concerning his/her dismissal from a previously attended institution in the event that such dismissal was disciplinary in nature.

All materials filed with the Office of Admissions will be forwarded to the academic standards committee of the college within the University to which the individual has applied. Prior to rendering a decision, the academic standards committee may require an interview with the applicant. After reviewing all previous academic records, the applicant's letter, and other pertinent documentation from the Office of Admissions, the committee shall forward its recommendation to the Director of Admissions. If the decision is to accept the applicant as a probationary student, the committee will further establish the requirements which the applicant must satisfy as a condition of probation. These shall include, at a minimum, the attainment of a cumulative average of 2.000 for the probationary semester.

The decision rendered by the academic standards committee shall be final as it relates to the applicant's admission to programs within the college to which the student has applied and also as it relates to the then current admission cycle. The evaluation of applicant credentials and the granting of transfer credit are accomplished subsequent to admission and according to program policies concerning transfer credits.

Other Associate Degrees and Certificates

Massachusetts public community colleges may award other associate degrees and certificates with a primary objective other than student transfer to a four-year institution. Course credits from such programs which are presented for transfer will be evaluated by the four-year institution according to their applicability to general education requirements, to unrestricted elective courses, and to requirements in the student's major field.

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Applicants for Additional Baccalaureate Degree

A student who has earned a baccalaureate degree at the University of Massachusetts Lowell or at another accredited baccalaureate institution may be admitted to the University to pursue an additional baccalaureate degree subject to the following requirements:

1. the nomenclature of the additional degree to be pursued must be distinctly different from the previously conferred degree;*
2. the major field of the previous degree must be clearly distinct from that of the additional degree;
3. the work for the additional degree must consist of not less than two semesters (or the equivalent) of full-time study;
4. the final 30 credits presented for the additional degree must be in addition to and independent of any previously-awarded baccalaureate; and
5. a minimum of 15 credits must be taken at the University in the major field which is presented for the additional degree.

*e.g., Bachelor of Arts, Bachelor of Science, Bachelor of Music, Bachelor of Science in Engineering, Bachelor of Science in Business Administration, etc.

Candidates for the additional baccalaureate degree must earn a minimum of 30 credits and must comply with any special college regulation concerning completion at the University of major field and professional program requirements (including collateral and prerequisite course requirements for the major/professional program). Second degree candidates may be eligible for major field honors but are not eligible for University honors unless they have completed 60 credits at the University for the additional baccalaureate degree.

Application for admission to the University as a candidate for an additional baccalaureate degree is made through the Office of Admissions. Prior to admission to the University as candidates for additional baccalaureate degrees, applicants must be approved by the college in which they plan to matriculate and the department in which they intend to major. Retention standards for candidates for additional

baccalaureate degrees are based upon the grade-point averages for achieving satisfactory standing which are specified for the several levels of course credits completed. Grade-point averages are computed solely on the basis of qualitatively graded courses which have been completed at the University for the additional baccalaureate degree. The number of course credits completed include those which have been applied from previous baccalaureate programs (cf. "Academic Policies: Determination of Academic Standing").

Application Procedures for Non-Matriculating Students

Admission as a non-matriculating student is granted only under provisions which govern the non-degree programs cited below. Applicants for admission as non-matriculating students are required to file admission applications and to submit such credentials as are specified for their proposed non-degree programs. A non-matriculated student may be readmitted subject to the following conditions: 1) the student has satisfactorily completed his or her previously attempted courses, 2) the original condition under which the student initiated non-matriculating studies permits continued enrollment, and 3) commitments of the University to matriculating students permit enrollment of non-matriculating students.

Dual Enrollment Program for High School Seniors

The Education Reform Act of 1993 introduced the Dual Enrollment Program, in which the Department of Education pays the tuition and fees for qualified juniors and seniors who attend any Massachusetts public high school. Students taking part in this program earn credits for their courses at both the high school and college level, and are required to have a 3.00 GPA or better, and be recommended by their principal or guidance counselor. Dual Enrollment students must file an application with the office of undergraduate admissions and submit high school transcripts, along with a parental signature allowing them to take classes on campus. The University reserves the right to decline admittance to students on the basis of academic ability.

Programs for Students Matriculated at Other Colleges and Universities (Visiting Students)

Students who are matriculants for degrees at associate or baccalaureate institutions may be admitted to the University to pursue specifically authorized courses. Such students are admitted to the University on a semester-by semester basis and must secure prior approval for University courses from appropriate authorities at institutions where their degrees will be granted. Permission to enroll in courses of the University will not be granted to students without a letter from an appropriate officer of the institution in which they are matriculating which certifies that they are candidates for a degree and are in good academic standing. Courses of a professional nature may not be elected by non-matriculating students of the University unless specifically authorized by the appropriate college dean.

Day Programs for Students Matriculating for Continuing Education Degrees of the University

Students who have established matriculation for University of Massachusetts Lowell continuing education degrees at either the associate or baccalaureate levels may be permitted to pursue specifically authorized day courses. Such students must secure the written approval of their program coordinators for all projected courses prior to filing an application with the Office of Admissions. Full notation of approved courses (including those which have been failed) is made upon the permanent record of continuing education students.

Programs for University Employees

University employees who are high school graduates or who possess certificates of high school equivalency may apply for admission as non-matriculating students. Admission is extended to employees as non-matriculating students on a semester-by-semester basis and solely for courses designated at the time of application.

Employees who wish to matriculate for a baccalaureate degree should apply for admission to the Encore Program. Participation in this program is subject to employee obligations and special policies of the Board of Trustees.

Non-Matriculating Programs for Students Holding Baccalaureate Degrees

An individual who holds a baccalaureate degree and who wishes to pursue a limited non-degree program (up to a maximum of 15 credits) may be admitted full- or part-time to the University as a non-matriculating student. Such admission requires the approval of each of the departments in which courses are contemplated. University of Massachusetts Lowell graduates should indicate their dates of graduation on their application forms. Other applicants must request the registrars of the institutions in which their degrees were conferred to mail transcripts of their baccalaureate records directly to the Office of Admissions and are warned that permission to enroll in courses will be denied if transcripts have not been received prior to course registration. A student who holds a baccalaureate degree and who wishes to pursue a second baccalaureate degree should investigate the appropriateness of both degree and non-degree programs of the Graduate School before applying for such status.

Readmission Procedures for Previously Enrolled Students of the University of Massachusetts Lowell (Non-Graduate)

The University does not grant leaves of absence to students who wish to interrupt their baccalaureate studies. Accordingly, students who have withdrawn from the University and who seek readmission must file an application for readmission with the Office of Admissions. When resources of a college or program render it necessary to establish limitations upon enrollments, the Office of Admissions will establish a waiting list of applicants for transfer and reinstatement. Differential admissions criteria above and beyond minimum program requirements may be

applied to these individuals to ensure the admission and readmission of the most qualified applicants for the limited openings.

Upper division students in the College of Health Professions who have withdrawn must make individual arrangements with appropriate chairpersons to reserve their spaces in courses for the semester of the anticipated return to the University. Unless such special arrangements have been made, reinstatement by the Office of Admissions cannot ensure full resumption of a student's course of study.

In the event that readmission applicants wish to change their programs and/or to seek readmission to the University in a college other than that which they previously attended, their reinstatement must be approved by the chairperson of the program to which they seek admission and the appropriate college dean. If program enrollments permit, approval for such readmission will be granted to students who satisfy all program admission requirements. Individuals who seek readmission to the University in a college other than that which they previously attended will be subject to re-evaluation procedures which are specified for enrolled students who seek an intercollegiate transfer (cf., policies governing intercollegiate transfers which appear elsewhere in this publication under the heading "Academic Policies: Change of Major with Intercollegiate Transfer"). Individuals who apply for intercollegiate transfers must submit their applications no later than November 1st for spring semester reinstatement and April 1st for fall semester reinstatement.

Unqualified Reinstatement

Individuals who were students in satisfactory academic standing prior to their withdrawal and who have not been absent from the University for more than one semester are automatically reinstated to the programs in which they were previously enrolled and are subject to curriculum requirements which are in effect for the classes to which they previously belonged. Application for readmission must be filed with the Office of Admissions.

Qualified Reinstatement

Students who have been absent from the University for two or more continuous

semesters are subject to the rules and regulations of the University which are in effect at the time of their readmission rather than at the time of their original admission. If program enrollments permit, individuals who were students in satisfactory academic standing prior to their withdrawal ordinarily are reinstated to the programs in which they were previously enrolled. However, during an individual's absence some programs may have established higher entrance and retention requirements and he or she may be denied reinstatement for failure to satisfy these requirements.

Individuals are not automatically reinstated to the programs in which they were previously enrolled when they have been absent from the University for periods exceeding ten years. Course work which has been completed prior to ten years of the date of readmission is generally recognized only through those examination procedures described in the policy statements for course equivalency. Such course work may also be evaluated on an individual basis by the academic standards committee of the college in which an applicant desires to re-establish his or her matriculation. Students who wish to have such course work evaluated by the committee must present their cases in writing to the committee no later than November 1st for spring semester readmission and April 1st for fall semester readmission. Such students who wish to re-establish their matriculation on a part-time basis should consider the Encore Program.

Individuals who have been suspended from the University for unsatisfactory academic standing may apply for readmission only within policies which govern probationary readmission.

Probationary Readmission

A student who has been suspended from the University is entitled to apply for readmission as a full-time probationary student but may not initiate his or her probationary studies before an absence from the University of one semester. Application for such readmission to all programs, except continuing education curricula, is made through the Office of Admissions and must be received by April 1st for a readmission decision during the spring semester and by November 1st for a readmission decision during the fall semester.

General Policies

Petitions which have been received by the filing deadline of November 1st will be reviewed by the appropriate academic standards committee during the fall semester, and readmitted students will be permitted to initiate their probationary studies at the beginning of the spring semester. Similarly, petitions which have been received by the filing deadline of April 1st will be reviewed by the appropriate academic standards committee during the spring semester, and readmitted students will be permitted to initiate their probationary studies at the beginning of the fall semester. Probationary studies may be authorized during the fall and spring semesters in day classes only.

Upon the receipt of an application, the Office of Admissions will forward all readmission papers to the academic standards committee of the college to which the student applies. Except as prohibited by the academic policies of professional colleges, suspended students may petition for readmission to the University with probationary status as follows: 1) all suspended students may petition for readmission to the college in which they were previously enrolled and may request re-enrollment in the former major or readmission with a change of major; 2) freshmen students and sophomore students who have not attempted more than 45 credits or have not completed more than three full-time semesters also may petition for simultaneous intercollegiate transfer and probationary admission to a new program. Students who have attempted 45 credits or three full-time semesters are not eligible for intercollegiate transfer at the time of probationary readmission.

Students who are readmitted to colleges from which they were previously suspended must achieve satisfactory academic standing for all course hours completed by the end of their probationary semester. Students who are permitted to make an intercollegiate transfer will be permitted to transfer all applicable courses which have been completed with grades of C or better and will be required to attain a probation average of 2.000 in order to achieve satisfactory academic standing.

After securing recommendations from appropriate departments and studying the previous academic record of the student, the academic standards committee will lay down the requirements which the student must satisfy as a condition for his or her

probation (specific courses to be taken, conference schedules with faculty advisors, and any other special or general academic condition which may be construed as necessary for the student's successful completion of his or her probationary studies). In determining such requirements for probation, the academic standards committees shall prescribe a sufficient number of courses for a student who has been readmitted to the college from which he or she has been suspended, which shall make the achievement of satisfactory academic standing reasonably possible during a full-time semester of probation. For complete information concerning probationary requirements, cf. "Undergraduate Academic Policies: Academic Standing."

Advanced Placement Policies for Baccalaureate Applicants

Students entering the University as freshmen or as transfer students may elect to challenge courses through established procedures cited below. University departments reserve the right to refuse the granting of credit for those examinations which are presented by a student for his or her major(s). Equivalency credit is granted for laboratory components of science courses only through examinations of University departments. Accordingly, science credits which are granted through the College Level Examination Program and Advanced Placement Examinations of the College Entrance Examination Board do not waive any specified laboratory requirement, including those of the University core curriculum.

College Level Examination Program: General Examinations

Entering freshmen may be granted University credit for general examinations if they have achieved minimum designated scores. General examination credit is granted at the time of admission only. Students who change major fields subsequent to receiving credit for general examinations are advised that previously granted credits are automatically nullified if their new majors are in an area in which general examination credit has been granted.

CLEP	Maximum Exam Score	Required Credits
English Composition*	550	3
Mathematics+	500	6
Natural Sciences+	500	6
Social Sciences#	500	6
Humanities@	500	6

* A score of 550 satisfies the requirements for College Writing I.

+ Credit may be granted only to students who matriculate for degrees in the College of Arts and Sciences and the College of Fine Arts. Natural science credit granted does not satisfy the specific laboratory course requirement of the revised University Core Requirements.

Credit may be granted only to students who matriculate for degrees in the College of Arts and Sciences, the College of Management, and the College of Fine Arts.

@ Credit will not be granted for a general examination in an area which is cognate with a student's major. For example, credit for the general humanities examination will not be granted to students who major in art, English, languages, music, philosophy, or other humanities areas.

College Level Examination Program: Subject Examinations

Entering freshmen and transfer students may be granted university credit for subject examinations of the College Level Examination Program when they have achieved scores which are on or above the C grade level. A complete listing of subject examinations of CLEP for which the University grants credits may be found elsewhere in this publication under the heading "Academic Policies: Course Equivalency Examinations."

Advanced Placement Examinations of the College Entrance Examination Board

Entering freshmen who have demonstrated college level proficiency through advanced placement examinations of the College Entrance Examination Board may be granted University credit for scores of

ADMISSIONS POLICIES

General Policies

5, 4, and 3. Credit will not be given for scores of 2 or 1.

The following is a listing of advanced placement examinations for which the University grants course credit:

AP Examination

Course Equivalent Credit

American History

- 43.111 U.S. History to 1877 and
43.112 U.S. History Since 1877 6 cr

Biology

- 83.101 Life Science I,
83.102 Life Science II,
83.103 Life Science I Lab &
83.104 Life Science II Lab 8 cr
or
81.111 Principles of Biology I,
81.112 Principles of Biology II,
81.113 Principles of Biology I Lab &
81.114 Principles of Biology II Lab 8 cr

Chemistry

- 84.121 Chemistry I,
84.122 Chemistry II,
84.123 Chemistry I Lab &
84.124 Chemistry II Lab 8 cr

Classics-Virgil

- 56.303 Selected Latin Authors 3 cr

Classics-Latin Lyric

- 56.303 Selected Latin Authors 3 cr

Economics

- 49.201, 202 Economics I & II 6 cr

English

- 42.101 College Writing I 3 cr

European History

- 43.105 Western Civilization and
43.106 The Modern World 6 cr

French Language

- 50.211 Intermediate French I and
50.212 Intermediate French II 6 cr

French Literature

- 50.261 Literature of Ideas and
50.262 Selected Writings 6 cr

German Literature

- 51.211 Intermediate German I and
51.212 Intermediate German II 6 cr

Government Politics

- 46.101 Intro in American Politics 3 cr

Physics C - Mechanics

- 95.141 Physics I 3 cr

Physics C - Electricity & Magnetism

- 95.245 Physics III 3 cr

Mathematics: Calculus AB

- 92.131 Calculus I 4 cr

Mathematics: Calculus BC

- 92.133, 134 Calculus III & IV
92.134 Calculus IV 8 cr

Music

- 74.161 Music of Western Civ 3 cr

Physics B

- 95.103 General Physics I and
95.104 General Physics II 6 cr

Psychology

- 47.101 General Psychology 3 cr

Spanish Language

- 54.211 & 212 Intro to Spanish I & II 3 cr

Spanish Literature

- 54.301 Intermediate Spanish Lit. 3 cr
54.302 Intermediate Latin American
Literature 3 cr

Foreign Language Achievement Tests of the College Entrance Examination Board

University credit is granted upon the recommendation of the Department of Languages to entering freshmen who have demonstrated satisfactory language competency through the Language Achievement Tests of the College Entrance Examination Board. University credit on the intermediate course level will be given to students achieving scores of 550 or better. Such credit will satisfy any language proficiency requirement specified for students by their major departments.

Course Credit Limits Through Advanced Placement With Credit

The maximum number of credits which may be granted to any student through advanced placement procedures, including departmental equivalency examinations, is 42 semester credits. Under no circumstances will duplicate examination

credit be granted to students who present formal course work for transfer. Nor will examination credit be granted to transferring students for the purposes of reducing either the major field residency requirement of 15 credits or the general residency requirement of 30 credits in University day courses.

Services for Learning and Physically Disabled Students

The University and its programs and activities are becoming increasingly more accessible to academically qualified students who are physically and learning disabled. Although some architectural barriers still remain, disabled persons can traverse the campus with a minimum of difficulty. University libraries, the student unions, several residence halls, and more recently-constructed classroom buildings are accessible to students in wheel chairs. Early registration, preferential scheduling, housing assistance, readers, notakers, interpreters, alternative testing procedures, reduced course load, and special parking arrangements are some of the accommodations available to disabled students. For further information contact the Office of Student Services, Cumnock Hall, North Campus.

Since admission to the University is based entirely on the academic qualifications of the applicant, admission procedures remain the same for all applicants, regardless of disability.

Equal Opportunity and Title IX

Federal and state laws require that no student be discriminated against or harassed on the basis of age, national origin, race, sexual orientation, religion, sex or handicapped, marital, or veterans status. The Affirmative Action office, which has the overall responsibility for the implementation of Equal Opportunity/ Affirmative Action, is located on the second floor of Dugan Hall (South Campus). This office deals not only with discrimination and harassment complaints but also with the monitoring of actual practice and written policies and procedures, e.g., student activities, course offerings, teacher and student attitudes. Any student who believes that he or she has been discriminated against or harassed or who believes

General Policies

that the University in any of its aspects is operating in a manner which adversely affects female, handicapped, minority students, or veterans should contact the Affirmative Action office immediately.

Health Certification Requirements for Admission

All students, as part of the condition of admission, are required to have on file a complete up-to-date medical history and physical exam form, evidence of a recent Mantoux +6 test,* and proof of completed up-to-date immunizations as mandated by law.

The college immunization law requires all full time students born after 1956 and all full or part time students in the health sciences, irregardless of age, to provide a medical certificate of immunization against measles, mumps, rubella, tetanus and diphtheria. The month and year must be given.

The measles vaccine must have been administered after 1968 and after the age of one, and there must be two doses at least one month apart.

The rubella vaccine must have been administered after one year of age. History of disease must be verified with a positive titer.

Proof of a mumps vaccination or physician diagnosed disease must be given.

The Tetanus-Diphtheria injection must be within the past ten years.

FINANCIAL INFORMATION



The information provided covers all matters relating to University expenses (including state, federal, and University policies governing fees, residency and non-residency tuition rates, payment schedules, tuition waivers, the New England Regional Program, and financial requirements for international students) and to financial aid programs (including V.A. benefits and scholarship, loan, and work-study programs).

University Expenses

Financial Information

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financial requirements for international students) and financial aid programs (including V.A. benefits and scholarship, loan, and work-study programs).

University Expenses

Undergraduate university-related costs (tuition, fees, housing, and board expenses) for Massachusetts citizens who reside on campus are approximately \$9,100 (1997-1998 estimate). Similar expenses for out-of-state students are approximately \$14,747. Additional costs for which the student should plan in estimating his or her total expenses include books, clothing, transportation, instructional supplies, and entertainment. Official University charges noted below and in the following sections concerning food services and student housing are in effect for the 1997-1998 academic year and are subject to change without prior notice by the Massachusetts Board of Higher Education or the Board of Trustees of the University of Massachusetts. All policy statements, tuition and fee charges, and other information detailed below reflect information current at the time of publication of this catalogue.

University Charges

University charges include tuition, mandatory fees, and applicable room and meal plan costs.

Undergraduate Tuition

Full-time (MA resident) \$1,700.00 per yr
Full-time (non-resident) \$7,347.00 per yr
Part-time (MA resident)* \$70.83 cr hr
Part-time (non-resident)* \$306.13 cr hr

*At the present time, tuition per credit hour is applicable only for the following students: a) students whose petitions for part-time enrollment have been approved by their college dean and by the Office of Academic Affairs; b) graduating seniors

with fewer than 12 credit hours to complete their degree requirements (an academic petition is required); c) students enrolled in the Encore Program or in the co-op program; and d) non-matriculated students enrolled in fewer than 12 credit hours.

Undergraduate University Fees

Application Fee (MA res) \$20.00
Application Fee (non-res) 35.00
International Student Fee-annual 76.00

Parking Fines

1st offense 5.00
2nd offense 10.00
3rd offense 15.00

Parking Fines-Handicapped Spaces

1st offense 25.00
2nd and subsequent offenses 50.00

Returned Check Fee-per check 30.00
Student Union Fee-annual 50.00
Transcript Fee-per transcript 1.00
Express Transcript Fee-per transcript 5.00
Univ Operating Fee-annual 2,646.00
Late payment fee-per semester 50.00

Room and Meal Plan Charges

Residence Hall

Double & triple occupancy rooms-annual \$2,580.00
Single rooms and suites are available at slightly higher annual rates
Telephone Service Fee-annual \$110.00

Meal Plans

7-meals per week-7 days
\$300-points-annual \$1,948.10
10-meals per week-7 days
\$250-points-annual \$1,986.70
10-meals per week-5 days only No week-ends, no "points" annual \$1,584.66
14-meals per week-7 days
\$126-points-annual \$1,986.70
19-meals per week-7 days No points-annual \$1,890.20

Insurance Charges

Liability Insurance-annual

College of Health Professions
Students on Clinical Affiliation \$16.00*

On-Campus Insurance

All Students (mandatory) -annual \$26.00*

Health/Accident Insurance

Single Student Rate mandatory, annual \$471.00*

Mandated by Chapter 15A, Section 7B of the Massachusetts General Laws and effective September 1, 1989 for every full-time and part-time student enrolled in a public or independent institution of higher education in the Commonwealth. Students who are able to provide evidence, satisfactory to the University, of insurance comparable to that required by the law may have this fee waived on an annual basis. Students must return evidence of comparable coverage, each year they are matriculated, by the established University deadline in order to have this fee waived.

*Estimated cost for coverage, 1997-98.

Explanation of University Charges

Tuition Rates

Tuition rates are established on the basis of official state residency. Eligibility for in-state tuition rates is determined by regulations governing Massachusetts residency. Eligibility for New England Regional Student Program tuition rates is determined by regulations administered through the New England Board of Higher Education.

University Fees

Application Fee

\$20.00 for Massachusetts Residents
\$35.00 for all others.

State law requires institutions of public higher education to collect specified application fees. This fee is not refundable and is not applicable to tuition. However, in certain cases of extreme financial need, it may be waived. A written recommendation from a Guidance Counselor, non-profit agency, or the College Entrance Examination Board should accompany any application for a waiver.

Financial Information

International Student Fee

International students require special services and numerous visas and other immigration forms before and after they arrive on campus. This fee is used to defray the cost of the staff, equipment, and consultants necessary to handle international students services.

Mass Student PIRG Fee

The Massachusetts Student Public Interest Research Group (Mass PIRG) is a state-wide, non-profit and non-partisan student-directed organization established to research and promote solutions to important environmental and social problems. It is a waivable fee benefiting the Massachusetts Student Public Interest Research Group is voted on by student referendum. For the year(s) in which the PIRG fee is not passed by student vote, it will not appear on the student invoice.

Student Union Fee

Funds derived from this fee are used to support the Student Union buildings.

Transcript Fees

A fee is charged to students who request transcripts of permanent academic records. Transcripts will not be released unless all bills are paid. Express Transcript Fee will apply if the transcript is required with less than 24 hours' notice.

University Operating Fee

The University Operating Fee is a curriculum support fee. This supports all aspects of student life, including such services as the library, computer center, athletic facilities, lab fees and equipment fees.

Late Payment Fee

A late charge will be assessed to anyone who is currently enrolled, has an outstanding balance, and does not have a legitimate exemption as of the due date on the invoice. Exemptions include participation in the AMS payment plan, sufficient outstanding financial aid and/or loans, or direct billing of an approved third party.

Residence Hall Charges

Residence Hall Rent and Reservation Deposit

Residence hall charges are billed and payable in two installments prior to the beginning of each semester, along with charges for tuition and fees. Each student must submit a \$200.00 room guarantee deposit at the time the residence hall reservation and contract is submitted. The deposit reserves the room until occupancy and is applied to the following spring semester residence hall charge. The deposit is non-refundable except in the case of an academic dismissal or graduation from the University.

Telephone Service Fee

This fee is levied upon each student occupying a room with individual telephone hook-up integrated into the University's telephone system.

On-Campus Insurance

Student on-campus insurance coverage for the academic year is obligatory for all matriculated and non-matriculated students. This insurance guarantees coverage of medical costs incurred due to mishaps on campus or while participating in a University sponsored event.

Student Health Insurance

A student health insurance fee is mandated by Chapter 15A, Section 7B of the Massachusetts General Laws and was effective September 1, 1989 for every full-time and part-time student enrolled in a public or independent institution of higher education in the Commonwealth. A family plan for married students is also available with options for coverage of spouses and/or spouses and dependent children. In addition, major medical coverage and a dental plan are available. For policies concerning compulsory reporting of illness or accident, consult Health Services.

Payment, Refund, and Waiver Policies

Payment, Refund, and Waiver Policies

Policies concerning University fees are determined by the University of Massachusetts Board of Trustees. Policies concerning room and meal plans are established by the Board of Trustees in conjunction with the Building Authority and food vendor, respectively. Tuition and tuition waiver policies are established either by the General Court, the Massachusetts Board of Higher Education, or the Board of Trustees of the University of Massachusetts.

Payment of Bills

Students will be permitted to attend classes and to utilize University facilities only after they have cleared all their financial obligations to the University. Financial obligations include indebtedness for library fines, parking fines, rental payments, and repayment of emergency loans. All bills are payable on or before the due date indicated on the student bills. Checks, money orders and major credit cards (Mastercard and VISA) are accepted. All payment of fees and tuition should be made payable directly to the University of Massachusetts Lowell. A student in debt to the University at the end of any semester or summer session is not permitted to register again at the University until his or her indebtedness has been discharged. Students are advised that the University utilizes the services of collection agencies authorized under the Commonwealth's Master Service Agreement, and students with seriously overdue accounts are liable for associated collection costs. In addition, student transcripts and diplomas will not be released unless all indebtedness has been discharged.

Payment Plans

The University of Massachusetts Lowell also offers a low-cost monthly payment option presently administered by Academic Management Services (AMS). This plan allows parents and students to budget the annual cost of tuition and fees over a ten- or a nine-month period. Informational brochures are available at the Accounts Receivable Office, located in Dugan Hall 128, or by calling the AMS toll free number: 1-800-531-4300.

Veterans Benefits

International Student Deposit

For students requiring an I-20 Certificate of Eligibility, a \$4,000.00 prepayment of University tuition and fees must be received and credited to their student account before the form can be issued.

Bookstore Financial Aid Voucher Program

If anticipated financial aid exceeds a student's financial obligation to the University and the student has been otherwise financially cleared, the Accounts Receivable Office can authorize a Bookstore Voucher to be used at the UMass Lowell Bookstore for the purchase of text books and school supplies. At the end of the drop/add course enrollment period, bookstore purchases made through this program are charged directly to the student account and will be deducted from that student's financial aid awards. Should the actual financial aid award be reduced for any reason, the student becomes personally responsible for charges to the bookstore. If complete payment is not made, as with all charges, University services may be withheld, and the financial obligation will be sent to a collection agency. In such case, the student assumes responsibility for all associated collection costs.

Overdue Accounts

Should it be necessary to utilize the services of a collection agency or attorney for an overdue student account, the student will be liable for any and all legal fees, commissions, and associated service charges.

Refund Policy

An undergraduate student who withdraws in writing from the University during the first half (50%) of the enrollment period will be granted a pro rata refund of tuition and designated fees. The enrollment period is defined as an academic term of 15 instructional weeks. The date of official academic withdrawal, as recorded by the Office of Enrollment Services, is the primary basis of any claim for tuition refund. Refund may also be authorized for documented reasons and/or extenuating circumstances deemed acceptable to the Associate Provost or his designee. Non-attendance of classes does not constitute withdrawal from the University. The refund policy is applicable to all full-time and part-time undergraduates, including those enrolled as non-matriculated undergraduates or through the Encore Program. It is not applicable to those enrolled

through Division of Continuing Education programs. Undergraduates are eligible for refunds of tuition and designated fees in accordance with the following schedules and notations:

Withdrawal Date	Refund Entitlement
On or before 1st day of classes	100%
Up to the first 10% of semester	90%
Between 10% and 25% of semester	50%
Between 25% and 50% of semester	25%

Under no circumstances are the application fees refundable. In addition, enrollment deposits, required for accepted

students, are refundable before May 15th for the fall term and December 15th for the spring term if the student withdraws in writing to the University. Under no circumstances are they refunded after these dates. Student Health and Student On-Campus Insurance are not refundable after the first day of classes.

In accordance with federal legislation, the University of Massachusetts Lowell has established a refund policy for students who are recipients of Federal Title IV financial aid monies. Consistent with federal regulation, any remaining refunds due the students will first be applied to cover any unpaid institutional charges before distributions are made to those students. Please contact the Accounts Receivable Office for further details.

The University of Massachusetts Lowell refund policy is subject to change without prior notice by the Board of Trustees of the University of Massachusetts.

Refund on Room Reservation Deposit

The \$200 room reservation deposit reserves a space in the residence halls until occupancy and is applied to the spring semester room rental. This deposit is non-refundable except in the case of an academic dismissal or graduation from the University.

Refund on Room Fees

All cancellations of room contracts must be submitted, in writing, to the Office of Residence Life. In addition to forfeiting their room reservation deposit, students canceling their housing contract for reasons other than academic dismissal or graduation will be responsible for the room fees according to the following schedule:

Cancellation Received by Residence Life	Obligation for Room Fees
Through July 15	No further obligation
July 16 through 1st day of classes	50% of fall fee
2nd day of classes through the last day in Nov	100% of fall fee
After last business day in November	50% of spring fee and 100% of fall fee

Reservation made after December 1st for spring semester

On or before 1st day of classes	50% of spring fee
On or after 2nd day of classes	100% of spring fee

Residents required to leave the residence halls and/or the University due to judicial sanctions will not be granted a refund of their room fees.

The Office of Residence Life has a Housing Contract Appeals Board to hear appeals from students who request exemption from the above refund schedule. This Board consists of the Associate Directors of Residence Life and the Assistant Dean of Students. Students may appeal their exemption from charges due to military obligations, change in personal situation, family finances, financial aid, illness, or other extenuating circumstances as may be deemed appropriate by the Appeals Board. All appeals must be documented in writing for review by the Appeals Board.

The finding of this Board can be appealed to the the Director of Residence Life whose decision is final.

Tuition Waivers for Senior Citizens

Tuition waivers are granted to senior citizens as specified by Massachusetts law. Citizens of Massachusetts who are age 60 and over (senior citizens) are entitled to free tuition at the University on a space available basis. Positive identification and proof of age must be presented. Applicable fees, including mandatory student fees such as the University Operating Fee, and costs of instructional materials (books, etc.) are not covered by this waiver. In addition, tuition for short-term intensive workshops or seminars is not covered by this waiver. Senior citizens who are admitted as matriculating students must satisfy established admission requirements for programs or must qualify for admission to the University through the Encore Program.

Financial Information

Rules Governing Massachusetts Residency for Tuition Purposes

Veterans Benefits

The Veterans Administration has approved the University of Massachusetts Lowell for undergraduate study. Veterans must present a certificate of eligibility available from the Veterans Administration, Kennedy Building, Government Center, Boston, Massachusetts. Upon receipt of this certificate, the University will notify the Veterans Administration to initiate monthly payments to the student. Veterans who are registered for twelve or more semester credits are paid for full-time training; for nine to eleven semester credits, three-quarter time training; and for six to eight semester credits, half-time training. A citizen of Massachusetts who is defined as a "Vietnam Veteran" and whose service is creditable to the Commonwealth may be issued a certificate of tuition exemption if he/she is enrolled in the University as a full-time student.

Certificates must be renewed annually prior to the beginning of each academic year, are in effect only during such time as the student remains in good standing at the University, are limited to a period of study which may not exceed four years, and are issued during an eight-year period from the date of discharge or release from active service. In order to receive a certificate of tuition exemption, an eligible veteran must present his discharge papers at the Office of the Adjutant General, State House, Boston, Massachusetts, and must provide the University's Financial Aid Office with a certificate of eligibility. A veteran who is entering the University for the first time is required to pay the application fee within the period designated on the application form for admission. The application fee is not refundable. Tuition exemptions do not cover fees of the University.

Rules and Regulations Governing the Residency Status of Student for Tuition Purposes

These rules and regulations apply to the classification of students at the University of Massachusetts as Massachusetts or non-Massachusetts students for tuition and fee purposes. The Massachusetts Board of Higher Education may revise this policy after the publication deadline for the 1995-96 catalog. In that event the revised policy will supersede the following

Part 1. Definitions

- 1.1 "Academic period" shall mean a term or semester in an academic year or a summer session, as prescribed by the Board of Trustees or under their authority.
- 1.2 "Continuous attendance" shall mean enrollment at the University for the normal academic year in each calendar year, or the appropriate portion or portions of such academic year as prescribed by the Board of Trustees or under their authority.
- 1.3 "Emancipated person", for the purposes of residency classification for tuition, shall mean a person who has attained the age of 18 years and is financially independent of his or her parents, or if under 18 years of age, (a) whose parents have entirely surrendered the right to the care, custody, and earnings of such person and who no longer are under any legal obligation to support or maintain such person; or (b) a person who is legally married; or (c) a person who has no parent. If none of the aforesaid definitions apply, said person shall be deemed and "unequipped as long as the conduct of an individual taken in total, manifests an intention to make Massachusetts his or her permanent dwelling place.
- 5) Former residency in Massachusetts and maintenance of significant connections there while absent.
- c) The following shall be secondary indicia of residency, to be considered of less weight than the indicia listed above in subsection b):
 - 1) Continuous physical presence in Massachusetts during periods when not an enrolled student;
 - 2) Military home or record;
 - 3) All other material of whatever kind or source which may have a bearing on determining residency.
- 3.2 Proof of Emancipation. A student asserting that he or she is an emancipated person shall furnish evidence to support such assertion. Such evidence may include:
 - a) Birth certificate or any other legal document that shows place and date of birth;
 - b) Legal guardianship papers - court appointment and termination must be submitted;
 - c) Statements of the person, his or her parent(s), guardian(s), or others certifying no financial support;
 - d) Certified copies of federal and state income tax returns filed by the person and his or her parent(s);
 - e) Where none of the foregoing can be provided, an affidavit of the emancipated person in explanation thereof and stating fully the grounds supporting the claim of emancipation.

Part III. Determination of Residency

- 3.1 Proof of Residency.
 - a) Each case will be decided on the basis of all facts submitted with qualitative rather than quantitative emphasis. A number of factors is required for residency to determine the intention of the person to maintain permanent residence in Massachusetts. No single index is decisive. The burden of proof rests on the student seeking classification as a Massachusetts resident.
 - b) The following shall be primary indicia of residency:
 - 1) For unemancipated persons, the residency of parents, having custody, within Massachusetts
 - 2) Certified copies of federal and state income tax returns;
 - 3) Permanent employment in a position not normally filled by a student;
 - 4) Reliance on Massachusetts sources for financial support;
- 3.3 Presumption, etc.
 - a) Residency is not acquired by mere physical presence in Massachusetts while the person is enrolled in an institution of higher education. (See Section 2.1).
 - b) A person having his or her residency elsewhere than in Massachusetts shall not be eligible for classification as a Massachusetts resident for tuition purposes, except as herein provided.
 - 1) Any person who is registered at the University as a Massachusetts resident shall be eligible for continued classification as a Massachusetts resident for tuition purposes (until

New England Regional Student Program

attainment of the degree for which he or she is enrolled) during continuous attendance at the institution.

- 2) The spouse of any person who is classified or is eligible for classification as a "Massachusetts resident" is likewise eligible for classification as a "Massachusetts resident". This provision will not apply in the case of a spouse in the United States on a non-immigrant visa.
- 3) A person who is an immigrant/permanent resident of the United States (or has applied for such status) is eligible to be considered a Massachusetts residency for tuition purposes provided that he/she meets the same requirements for establishing residency in Massachusetts as are required of a United States citizen. Non-Citizens who are in (or who have applied for) refugee/asylum status are likewise eligible to be considered for Massachusetts residency for tuition purposes provided that he/she meets the same requirements for establishing residency in Massachusetts as are required of a United States citizen. All non-citizens must provide appropriate documentation to verify their status with the United States Immigration and Naturalization Service.
- 4) Those students whose higher educational pursuits are funded by the Department of Welfare, the Massachusetts Rehabilitation Department, or any of the other Commonwealth of Massachusetts public assistance programs.
- c) A person does not gain or lose in-mancipated person".
- 1.4 "Parent" shall mean
 - a) the person's father and mother, jointly;
 - b) if the person's father is deceased, the person's mother; if the person's mother is deceased, the person's father;
 - c) if a legal guardian has been appointed by a court having jurisdiction, the legal guardian;
 - d) if neither the father or mother is living

and no legal guardian has been appointed, the person who then stands in loco parentis to the person;

- e) if the father and mother are divorced, separated or unmarried, the parent who has been awarded legal custody of the person; or if legal custody has not been awarded, the parent with whom the person lives. With respect to any adopted student, the word "adoptive" should be inserted before the words, "father" and "mother" wherever used.

1.5 "Reside", "residency" or "resident" shall mean "domicile", i.e., a person's true, fixed and permanent home or place of habitation, where he or she intends to remain permanently.

Part II. Classification

2.1 For the purpose of assessing tuition, and fees, each student shall be classified as a "Massachusetts resident" or a "non-Massachusetts resident". A person shall be classified as a Massachusetts resident if he or she (or the parent of an unemancipated student) shall have resided in the Commonwealth of Massachusetts for purposes other than attending an educational institution for twelve months immediately preceding the student's entry or reentry as a student.

Physical presence for this entire twelve-month period need not be reqstate status solely by reason of his or her presence in any state or country while a member of the Armed Forces of the United States.

- d) For the purposes of this policy the following persons shall be presumed to be Massachusetts residents:

- 1) A member of the Armed Forces of the United States who is stationed in Massachusetts on active duty pursuant to military orders, his or her spouse and dependent students.
- 2) Full-time, faculty, professional staff, and classified staff employees of the University of Massachusetts system and their spouses and dependent students.

Part IV. Appeals

Any student or applicant who is unwilling to accept the initial ruling relative to his or her residency classification may file a "Residency Reclassification Form".

Any student or applicant who is unwilling

to accept the ruling related to his/her residency reclassification may submit a letter of appeal to the University's Residency Appeal Committee. The decision by this Committee is final and may not be appealed further.

In any case where the Admissions Office is unable to make an initial determination based on the evidence submitted, the applicant may be required to submit a "Residency Reclassification Form" to the admissions office for their review before being finally classified as a resident or a nonresident.

Part V. Penalties

Misrepresentation in or omission from any evidence submitted with respect to any fact, which if correctly or completely stated would be grounds to deny classification as a Massachusetts resident, shall be cause for exclusion or expulsion from or other disciplinary action by the University.

Part VI. Deadlines

Written appeal of an initial classification or of a reclassification request may be initiated at any time, though students are encouraged to submit such an appeal as early as possible. While initial classifications and reclassifications are normally effective for the term of the student's entry or reentry to the University, students may apply for subsequent terms and will be evaluated for the semester. (These rules and regulations were passed by the Board of Trustees 2/1/95 and revised 12/6/95.)

New England Regional Student Program

Students who meet the eligibility requirements for residents of their state and admission requirements of a University program approved as a regional curriculum will receive preference in admission among out-of-state applicants and will be charged the in-state tuition plus 50% upon admission. It is assumed that students accepted into a program of study offered under the New England Regional Student Program will remain in the same field of study. If a student transfers into a program which is not included in the regional student program, out-of-state tuition will be applicable as of the date of transfer.

The following is a listing of programs of the University of Massachusetts Lowell which are offered under the New England Regional Student Program.

Financial Information

Scholarships

University of Massachusetts Lowell Programs	Eligible States*
American Studies	RI, VT
Criminal Justice	NH, RI
Environmental Science	ME, RI
Health Education	RI, VT
Meteorology	ME, RI, VT
Music Business	CT, ME, NH, RI, VT
Nuclear Engineering	CT, ME, NH, RI, VT
Plastics Engineering	CT, ME, NH, RI, VT
Sound Recording Technology	CT, ME, NH, RI, VT

*Students are advised that the list of approved university programs differs from that which has been approved for state colleges.

Financial Aid

The Office of Financial Aid was established to provide students with the financial assistance necessary to reach their educational goals.

Financial aid consists of scholarships and grants (the awarding of money for which no re-payment is required), self help in the form of loans (money lent to a student to be paid during a specified period, usually following the termination of University studies), and employment (government- or University-sponsored work for all or part of an academic year). Awards are made on a yearly basis and are dependent upon the availability of funding from specific sources, proven financial need, and the criteria of specific financial aid sources.

Selected candidates for financial aid must submit copies of Internal Revenue form 1040 for both their parents and themselves to the financial aid office.

University Administered Federal Assistance Programs

At the University of Massachusetts Lowell, financial aid is available to students who are citizens of the United States or who have permanent visa status. Aid is granted for the fall and spring semesters, and in some instances, for summer sessions. In order to qualify for financial aid, all incoming and transfer students must file a Free Application for Federal Student Aid (FAFSA). This one form, which enables students to be considered for all types of assistance including Direct Stafford Loans (GSL), is available in most high school counseling offices and college financial aid offices. Students are encouraged to apply

as early as possible beginning January 1 and to be certain that the form is postmarked by no later than March 1.

Satisfactory Academic Progress

All students should be aware that the ultimate mandate under federal regulation requires that in the absence of approved extenuating circumstances, a student who fails to meet the minimum institutional requirements of his or her program, following periods of warning and probation, is no longer eligible for any federal financial aid funds.

Pell Grant

All students in need of financial assistance must file for the Pell Grant program since the criteria of this program are the basis for determining student needs. Students, except those who have earned a baccalaureate degree, must apply by completing the Free Application for Federal Student Aid. The amount of the grant will be dependent upon funding available and may vary from year to year.

Supplemental Education Opportunity Grant

In conjunction with other forms of financial aid, (with priority given to Pell Grant recipients) supplemental grants provide assistance to students of exceptional financial need who would not otherwise be able to consider a college education without attendant indebtedness which would seriously impair future careers.

College Work-Study Program

Under the work-study program, a student who meets established financial aid criteria can be assigned part-time employment on campus. Students work an average of 15 hours per week while attending classes full time and may be employed up to 40 hours per week during vacation and summer periods.

Job Locator Program

This program offers part-time and summer employment for students with or without financial aid. It is available to provide off-campus jobs. Often students are able to find placement in their field of interest.

Direct Loan Program

Federal Direct Subsidized Stafford Loan

This is a subsidized loan, which means that the federal government will pay the interest on the loan while the student is in school and during specified deferments, but the student must demonstrate financial need to receive the loan.

Federal Direct Unsubsidized Stafford Loans

Students may be awarded this unsubsidized loan regardless of need but will have to pay all interest charges.

Federal Direct PLUS Loan

Credit worthy parents of dependent students can borrow a PLUS loan to pay for the student's education.

Other Loans

Perkins Loan

A long term, low interest federal loan. Payment begins after borrower ceases to be a student. Borrowers are advised that loans in default may be brought to litigation and court judgments sought.

Mass Plan Family Education Loan

Offered through the Massachusetts Educational Financing Authority (MEFA) It is a program designed to assist families that have students attending colleges and universities in Massachusetts. For further information, call MEFA at 1-800-449-MEFA.

TERI, Alliance Supplemental Loans, etc.

Undergraduate or graduate students must be credit worthy to participate.

Tuition Payment Plan

For a small non-refundable fee and with no interest charges, student and parents can avoid large lump sum payments for educational expenses by paying over a ten month period. The plan allows parents to "pay as you go" without accruing interest charges or withdrawing assets. For more information contact (AMS) Academic Management Services, Inc. at 1-800-635-0120.

Special Student Loan

Office of Student Services

Limited, short-term loans are made to cover unexpected personal emergencies. These loans are to be repaid at a time specified by the loan note, which a student must sign at the time an emergency loan is granted.

Scholarships and Awards Primarily for Underclassmen

Scholarships

Scholarships are provided by the Commonwealth of Massachusetts and the University. Funds for University scholarships are derived from business, industry, and private donations.

MASSGRANT Scholarships

A scholarship awarded to undergraduate Massachusetts residents who apply when filing their FAFSA by May 1st. Must be a permanent Massachusetts resident for a minimum of one year and attend school on a full-time basis.

University Scholarships and Awards

The University of Massachusetts Lowell has endowed scholarship funds to assist students who satisfy qualification requirements designated by the donors. Upperclassmen are requested to check with their department chairperson for further details.

Scholarships and Awards Primarily for Underclassmen

Alumni Association Scholarships

Scholarships to assist with tuition and/or miscellaneous fees and are renewable provided satisfactory academic standing is maintained. Matriculating students are eligible to apply.

Eastman Kodak Undergraduate Scholarship

This scholarship is granted to University departments from which certain employees of Eastman Kodak have graduated and is awarded in accordance with departmental policies. See your department chairperson.

Genradco Trust Scholarship Fund

Scholarships are awarded from this scholarship fund to the highest ranking female and male student in each of the three upper classes, and are restricted to students majoring in industrial technology.

Barnett D. Gordon Award

The award is made to an incoming freshman who has achieved the highest score in the mathematics examination of the Scholastic Aptitude Test.

Honeywell Fund Scholarship

A generous gift from Honeywell is to be utilized as follows: three-fourths to be

awarded to students solely on the basis of need and one fourth to be awarded to upperclassmen in the field of electro-optics.

Lowell Sun Charities Scholarship Fund

This fund, established by the Lowell Sun Charities, provides annually renewed scholarships for Greater Lowell residents. Recipients must demonstrate good moral character as well as high academic standing.

Rosemary Peirent Scholarship Award

Reserved for an incoming freshman graduating from Tewksbury Memorial High School. Check your school guidance office.

Mark Wagner Memorial Scholarship

This scholarship is awarded to a student majoring in music. Applicants must be residents of the Greater Lowell area for a period of not less than five years, demonstrate financial need, and maintain satisfactory academic standing.

Jacob Ziskind Memorial Fund for Freshmen

Scholarship funds are restricted to freshmen. Recipients must exhibit good character, scholastic aptitude, initiative, and ability.

Scholarships and Awards Primarily for Upperclassmen

AID Awards and Trust Fund

Awarded to non-traditional minority students in good academic standing, financial need, and either have demonstrated leadership ability through community involvement and/or involvement in extra-curricular activity, or have demonstrated very significant academic improvement.

Allied Chemical Corporation Scholarship

The Allied Chemical Corporation has made available on a one-year basis a scholarship for an upperclassman majoring in plastics.

Michael K. Anderson Memorial Scholarship

Established by Irving Anderson in memory of his son Michael, this award is made to a student in the College of Fine Arts who is under the age of 25.

Custom Materials Scholarship, Division of 3M Corporation

Custom Materials of Chelmsford has made available on a one-year basis a scholarship for an upperclassman majoring in plastics technology.

American Hoechst Corporation, Plastics Division, Scholarship

This company of Leominster, Massachusetts makes available two one-year scholarships to deserving students in plastic technology. Recipients must be residents of Massachusetts, with preference given to students living in the Leominster area. Other students may qualify if applicants from Leominster or Massachusetts are ineligible. Qualifications include participation in extra-curricular activities and suitable personality characteristics.

Gehrig Foundation Memorial Scholarships

Scholarships in the memory of Henry C. Gehrig and his son, Edward, are made available to upperclassmen.

Massachusetts Association of Land Surveyors and Civil Engineers (MALSCE) Scholarships

Awarded in memory of Charles Anderson and Llewellyn Schofield. The student must be a civil engineering major, a resident of Massachusetts, and have completed the freshman year. See chairperson of department.

Mobay Scholarship

The Mobay Chemical Corporation of Pittsburgh sponsors a scholarship on a one-year basis which is awarded to the deserving upperclassman in plastics engineering.

National Association of Plastics Distributors Scholarship

\$1,000 scholarship awarded to a student majoring in plastics engineering. See department chairperson.

NYPRO Scholarship, Division of E. I. DuPont de Nemours

Awarded to a plastics engineering sophomore, renewable for junior and senior years. Preference is given to employees or children of employees or residents of Worcester County area. Must have a GPA of 2.700 or better.

Financial Information

Scholarships and Awards Primarily for Underclassmen

Plastics Engineering Scholarships

Each year companies in the plastics industry make funds available for scholarships to students in plastics engineering. Applications may be obtained from the scholarship committee in the plastics engineering department. See department chairperson for details.

Society of Plastics Engineers Scholarships

Two scholarships are granted annually by the Eastern New England Section of the Society of Plastics Engineers, Inc., to upperclassmen majoring in plastics engineering. One scholarship is awarded by Southeastern New England Section of the Society of Plastics Engineering to an upperclassman majoring in plastics engineering.

Carl Tapper Award

This award is made to a senior in the College of Fine Arts who has established the best record in the two required semesters of apprentice teaching and who shows the most promise for success in a career of music education.

Jacob Ziskind Memorial Fund

This fund, established by the Trustees of the Jacob Ziskind Trust for Charitable Purposes, provides scholarships to sophomores, juniors, and seniors who have demonstrated high scholastic accomplishment, exhibit qualities of good character and leadership, and who are in need of financial assistance. Preference is given to those students who have received grants from the Jacob Ziskind Memorial Fund for Freshmen.

College and Department Scholarships

Edward Alexander Scholarship

College of Arts and Sciences

Daniel Cole Scholarship

College of Arts and Sciences

Cheney E. Cook Scholarship

College of Arts and Sciences

Roland E. Derby Memorial Scholarship

College of Arts and Sciences

Russell W. Ehlers Scholarship

Department of Plastics Engineering

Elmer Fickett Scholarship

College of Arts and Sciences

Dr. Patricia Goler Scholarship

College of Arts and Sciences

Green Memorial Scholarship

College of Arts and Sciences

Mary C. Hall Foundation Scholarship

Department of Mathematics

William Haskell Scholarship

Department of Civil Engineering

Russell Weeks Hook Scholarships

College of Arts and Sciences

Bernard Killion Memorial Scholarship

College of Arts and Sciences

Charles T. Main Scholarship

College of Arts and Sciences

McCaffery Memorial Scholarship

College of Arts and Sciences

Raymond O. Normandin Scholarship

Department of Plastics Engineering

Dr. Daniel O'Leary Scholarship

College of Arts and Sciences

Paul C. Panagiotakos Scholarship

Department of Chemistry

Pinanski Scholarship

College of Arts and Sciences

Ready Scholarship

College of Arts and Sciences

Allen Scattergood Scholarship

College of Arts and Sciences

William Segal Scholarship

College of Arts and Sciences

Academic Policies



Each University student is subject to two sets of academic regulations—those of the University as a whole, which are cited in this chapter, and the academic rules of the college and program in which he or she is enrolled. The academic rules of colleges and programs are listed in chapters devoted to college programs.

In registering for courses, each student assumes full responsibility for knowledge of and compliance with the definitions, regulations, and procedures for the University, as set forth in this publication. Moreover, in accepting admission to the University, each student assumes responsibility for knowledge of and compliance with the definitions, regulations, and procedures of the University pertaining to his or her student status as set forth in the appropriate University of Massachusetts Lowell publications and catalogue.

Students who have questions about the interpretation or application of University academic policy should consult the dean of their college or the Director of Enrollment Services. Please note that these policies are under continuous review and that the most up-to-date set are always published as "Yellow Pages" in each semester's schedule of classes book.

*Baccalaureate Degrees***Baccalaureate Degrees**

Undergraduate programs which are offered by the University of Massachusetts Lowell lead to one of the following degrees: Bachelor of Arts, Bachelor of Fine Arts, Bachelor of Liberal Arts, Bachelor of Science, Bachelor of Music, Bachelor of Science in Business Administration, Bachelor of Science in Industrial Management, Bachelor of Science in Engineering, and Bachelor of Science in Engineering Technology.

Bachelor of Arts Degree

Curricula leading to the Bachelor of Arts degree are designed to provide a broad, comprehensive education with many options for developing major and minor programs. These options are specified by each of the colleges offering Bachelor of Arts degree programs and are sufficiently flexible to satisfy the individual needs of students while also providing sufficient preparation in the major field for subsequent specialization at the graduate level. All Bachelor of Arts degree programs require completion of a major within the college in which the student is a degree candidate and (except as specified by policies concerning second majors) a minimum of 75 credits outside the major field. The following is a listing of major fields in which the Bachelor of Arts degree is presently offered by colleges of the University.

College of Arts and Sciences

American Studies

Chemistry

Economics

English

Environmental, Earth, and Atmospheric Sciences

History

Modern Languages

Philosophy

Political Science

Psychology

Sociology

College of Fine Arts

Music (General)

Bachelor of Science Degree

The Bachelor of Science degree is designed to provide students with a broad scientific education with specialized training in one or more of the basic sciences (e.g., biological sciences, mathematics, meteorology, etc.) or to combine a general education with a specialized applied program (e.g., health education, nursing, criminal justice, etc.). Curricula which are offered in areas of the natural sciences and mathematics provide opportunities for major and minor program options but afford greater opportunities for major specialization than are permitted in comparable Bachelor of Arts curricula. All Bachelor of Science degree programs require completion of a major within the college in which the student is a degree candidate and a minimum of 50 credits outside the major field. The following is a listing of major fields in which the Bachelor of Science degree is presently offered by the colleges of the University.

College of Health Professions

Clinical Laboratory Sciences

Clinical Lab Sciences option

Medical Technology option

Exercise Physiology

Health Education

Nursing

College of Arts and Sciences

Biological Sciences

Chemistry

Computer Science

Criminal Justice

Environmental, Earth, and Atmospheric Sciences

Mathematics

Applied Math option

Pure Mathematics option

Computer programming option

Mathematical Statistics option

Physics

Applied Physics option

Optics option

Radiological Health Physics

Other Baccalaureate Degrees

Bachelor of Fine Arts, Bachelor of Music, Bachelor of Liberal Arts, Bachelor of Science in Business Administration, Bachelor of Science in Industrial Management, and Bachelor of Science in Engineering degree programs have been determined by the requirements of specific career objectives and are subject to the recommendations of such professional associations as the National Association of Schools of Music and the Accreditation Board for Engineering and Technology. Course requirements for these professional degree programs are specified in terms of the total course of study and without reference to academic options which are available to students under Bachelor of Arts and Bachelor of Science degree programs.

General Degree Requirements

To qualify for University degrees, baccalaureate candidates are required to obtain 2.00 (C) averages in their total course of study; to present a minimum of 120 semester credits; to fulfill the minimum residency requirement which is designated for University day courses and for each major; to satisfy the regulations and academic standards of the colleges which exercise jurisdiction over the degrees for which they are matriculating; to complete all curriculum requirements specified by the college in which they are enrolled and department(s) in which they are majoring; and to complete the University general education requirements.

*General Degree Requirements***University General Education Requirements**

The University General Education requirements consist of the following:

All students are required to satisfy the General Education Requirements, which include a minimum of 36 credits. In fulfilling the following requirements (except Sciences), students may take no more than one course from a single department. The two course College Writing requirement is a separate service of the English department and does not affect that department's participation in the other categories of general education.

Aesthetics: one course, three credits.

Behavioral and Social Sciences: two courses, six credits.

College Writing: two courses, six credits.

Historical Studies: one course, three credits.

Literature: one course, three credits.

Mathematics: one course, three credits (to meet required skill level).

Sciences: three courses, nine credits minimum, with at least two courses that include some form of experimental learning.

Values, Concepts, and Choice: one course, three credits.

Residency Requirements

All baccalaureate degree candidates must satisfy both general and major field residency requirements.

General Residency Requirements

All candidates for baccalaureate degrees, exclusive of categories four and five below, must complete 60 semester credits at the University of Massachusetts Lowell. In any event, all candidates for non-continuing education baccalaureate degrees must complete 30 credits of full-time study in University day courses. The following residency options apply, as specified, to candidates for baccalaureate degrees:

1. complete three years in the University, earning not less than 90 credits (30 of which must be earned in University day

classes), and an approved junior or senior year program at another accredited baccalaureate institution, earning not more than 30 semester credits or the number of semester credits which is specified for juniors or seniors by those prescribed courses of study which are listed in this catalogue.

2. complete an associate's degree at the University of Massachusetts Lowell (Division of Continuing Education) or at a Massachusetts community college under the provisions of the Commonwealth Transfer Compact and complete the last two years at the University, earning not less than 60 credits (30 of which must be earned in University day courses);
3. complete up to the first two years in an accredited two-year institution, earning not more than 60 semester credits with grades of C (2.00 on a 4.00 scale) or better, and the remaining years in the University, earning not less than 60 semester credits (30 of which must be earned in University day courses);
4. complete up to the first three years of a baccalaureate program in an accredited four-year institution earning not more than 90 semester credits, with grades of C (2.00 on a 4.00 scale) or better, and the remaining year(s) in full-time study in University day classes, earning not less than 30 credits; or
5. complete up to the first three years of a continuing education baccalaureate program at the University of Massachusetts Lowell and the remaining year(s) in full-time study in University day classes, earning not less than 30 credits.

The requirement of 30 semester credits of study in University of Massachusetts Lowell day courses may not be satisfied through course equivalency procedures. However, residency requirements over and above this requirement may be satisfied subsequent to admission to the University through these procedures.

With the approval of the appropriate college dean, up to 15 credits of the minimum day course requirement also may be satisfied through completion of courses in the University of Massachusetts Lowell Continuing Education.

Students who matriculate for degrees under provisions of the Encore Program must satisfy requirements in University day classes as specified (including the requirement specified below for the major) but may fulfill these requirements on either a full-time or part-time basis.

An individual who has been admitted to day courses of the University as a non-matriculating (special) student is not considered a student in residence. If subsequently admitted as a matriculating student, such an individual must petition the college dean for recognition of non-matriculated courses. Up to 15 credits of non-matriculated courses may be recognized for application to the minimum residency requirements of 30 semester credits of University courses.

Residency Requirement for Major Fields

Baccalaureate degree candidates must complete at least 15 semester credits within the academic department(s) in which he or she is majoring for each major which is presented for a degree. Upon the approval of the appropriate college dean, the course requirement of 15 credits within the major department may be satisfied through satisfactory completion of courses in the University of Massachusetts Lowell Continuing Education.

Dual Degree Program: Bachelor of Arts and Bachelor of Science in Engineering

Students who wish to pursue the dual degree program in the College of Arts and Sciences and the College of Engineering must establish simultaneous matriculation in both colleges and designate candidacy for two degrees. The curricula for dual degree programs are approved by participating college faculties and must be completed as prescribed. It is therefore imperative that a student who wishes to pursue an approved dual degree program obtain a copy of the specified curriculum which enumerates the specific semester-by-semester course requirements. Students interested in this program should direct their inquiries to the office of the Dean of the College of Arts and Sciences or the Dean of the College of Engineering.

*Declaration of Major***Major Field Requirements**

Candidates for the Bachelor of Arts degree may not be required to take more than 45 credits in their major fields. Candidates for the Bachelor of Science degree may not be required to take more than 60 credits in their major fields. However, candidates for either degree may elect to take additional courses in the major beyond the specified maximum providing that such additional courses are not presented for the minimum degree requirement of 120 credits.

Declaration of Major

Students who have declared a major at the time of their admission to the University are officially enrolled in the college in which their designated major is offered and are referred by the college dean to the chairperson of the designated major for assignment of a faculty advisor.

Although the University does not require students to declare their major fields until they have achieved 60 semester credits, an early decision by students will greatly facilitate the selection of appropriate prerequisite courses for major fields and accordingly will reduce the possibilities of time-consuming errors in judgment.

Students enrolled in the College of Arts and Sciences are strongly encouraged to declare their major fields by the end of the freshman year. Students contemplating majors in chemistry or environmental sciences should initiate prerequisite course work immediately upon entrance to the College of Arts and Sciences and should make a declaration of major at this time or prior to the end of the freshman year.

Students in the College of Health Professions should not delay declaration of major beyond the freshman year.

Additional course work beyond the minimum degree requirement and extension of the normal four-year period of study may be expected when individuals make a declaration of major later than recommended above.

Students who make no declaration of major prior to the end of their sophomore year are listed as undeclared students for their first two years. Individuals who wish

to designate a major which is offered by the college in which they are enrolled as undeclared students must secure the signature of the appropriate department chairperson (or the chairperson of the committee which exercises jurisdiction over an interdepartmental major) on a declaration of major form and must file the completed form with the Office of Enrollment Services. Individuals who wish to designate a major which is not offered by the college in which they are enrolled as undeclared students must file an approved form for intercollegiate transfer and declaration of major with the Office of Enrollment Services. This form requires the signatures of the dean of the college to which the student transfers and the appropriate department chairperson.

Undeclared students are advised that openings may be limited or unavailable in some programs and that differential admissions criteria may be applied to program or college applicants when staffing or facilities render it necessary to establish limitations upon enrollments.

Declaration of Second Major

Students who wish to declare a second major should consult with their college dean to determine if a second major can be completed within specified degree requirements or will require additional study beyond the minimum degree requirements and extension of the regular period of baccalaureate study. Students who wish to declare a second major in the college in which they are enrolled as degree candidates ordinarily may do so by filing an approved declaration of second major with the Office of Enrollment Services. Students who wish to declare such a major in another college of the University may do so only when regulations of that college and the college in which they are enrolled as degree candidates both permit. Such declarations require the approval of both college deans. Students who are permitted to carry two majors are assigned an advisor in each major department.

Individuals who are matriculating for the Bachelor of Arts degree may not count more than 63 credits in the two academic majors combined toward the minimum

degree requirement of 120 credits. Students who present more than 63 credits in the two majors combined may not present less than 57 semester credits outside the two major fields in satisfying the minimum degree requirement of 120 credits. Accordingly, students who present more than 63 credits in the two majors combined must present a number of credits beyond the minimum degree requirement of 120 credits which is equal to the number of credits by which they exceed the combined major credit maximum.

Except as noted under the heading "Dual Degree Program," students who elect academic majors in more than one college are candidates for one degree only, and they are considered to be degree candidates in the college of their initial major unless they indicate to the contrary by filing for intercollegiate transfer at the time they make a declaration of second major.

Accordingly, a student who pursues academic majors in two colleges is subject to all degree requirements as specified by the college of his or her initial academic major and is subject only to major course requirements (including collateral and prerequisite courses for the major) as specified by the department of his or her second academic major. Individuals who pursue double majors within different degree programs will receive the degree which is designated for their initial academic major unless they have filed for intercollegiate transfer when they filed a declaration of second academic major.

Professional programs in business administration, engineering, health education, clinical laboratory sciences, nursing, exercise physiology, industrial management, and Bachelor of Music programs may be designated as degree majors only.

Although students in these programs may be permitted to pursue a second major in an academic field which is offered by another college, they are subject to all degree requirements as specified by the college for the professional major.

*Change of Major***Change of Major**

Once students have begun a program of major studies, they may change their major field only by filing an approved change of major form with the Office of Enrollment Services. Students who make substantial changes in their plans of study after the beginning of the sophomore year, regardless of major, ordinarily will find it impossible to complete degree requirements within the normal four-year period of study and may also find it necessary to redesignate their choice of degree.

Students who have been placed on academic warning should review their choice of major and should contemplate a change of program.

Change of Major within College of Enrollment

Students who wish to change their declarations of major within the college in which they are enrolled as degree candidates are required to file an approved change of major form with the Office of Enrollment Services. This form requires the approval of the chairperson of the major department to which the student desires to transfer and should be filed by November 1 for spring semester transfer and by April 1 for fall semester transfer in order to insure proper advising during the periods of fall and spring pre-registration. Filing after the recommended dates may be permitted by the chairperson of the department having jurisdiction over the new major. Students anticipating a change of major may drop irrelevant courses if applicable University rules permit (cf. "Withdrawal through the 50th Class Day" and "Reduced Load Status"). The symbol X may not be assigned to courses which are dropped after the 50th class day because a student intends to change a major.

Change of Major with Intercollegiate Transfer

Students desiring to transfer from a baccalaureate continuing education program to a baccalaureate day program, to transfer from a baccalaureate day program to a baccalaureate continuing education program, or to drop a major which is offered by the

college in which they are matriculating and to add a major which is offered by another college of the University must apply for intercollegiate transfer.

An individual seeking an intercollegiate transfer must file an academic petition and a transcript with the chairperson and dean having jurisdiction over the program to which transfer is desired. Following endorsement by both the chairperson and the dean, this form must be filed with the Office of Enrollment Services. Individuals petitioning for intercollegiate transfer are required to satisfy the admissions requirements of their desired college and program and, irrespective of any initial favorable decision concerning such petition, they will not be permitted to transfer if they have been suspended from the University after they have been accepted for transfer.

Continuing education students transferring to day college programs should refer to policies under the heading "Residency Requirement" for specification of the number of credits which must be completed in regular day classes.

Individuals seeking transfer from one college to another are advised that openings may be limited or unavailable in some programs, that differential admissions criteria may be applied to program or college applicants when staffing or facilities render it necessary to establish limitations upon enrollments, and that the completion of degree requirements within the customary four-year period may not be possible since the correction of deficiencies cannot always be accommodated within the schedule of course offerings.

The official date of intercollegiate transfer is the first day of the semester following approval of a student's application. Since course pre-registration is conducted prior to the official date of transfer, students should make immediate arrangements for pre-registration counseling with the dean of the college to which they will transfer. Subsequent to approval of a student's application for transfer and prior to the official date of transfer, the college dean shall review the academic record of the student to determine the applicability of previously completed courses to the requirements of the college and, if appropriate, the new major.

Minor Area Requirements

The requirements for minors are established by University departments or by interdisciplinary committees. No minor program may consist of less than 18 semester credits in the minor field nor more than 24 semester credits. At least six credits must be completed at the upper-division course level for all minor studies. Students are advised that an aggregation of courses which total 18 or more credits does not constitute a minor field. Specific options for minor programs will depend on the major field which a student has elected to pursue and collateral course requirements which have been specified by major departments. Although minor programs generally may be elected without specific authorization of departments offering such programs, some minors do require such authorization. In any event, individuals who are interested in electing a minor program should consult the relevant section of this publication for curriculum requirements and prerequisites. Only one minor program is officially noted on the student's permanent record.

Language Requirement

Although the University does not require language proficiency, as such, for any degree, each faculty having jurisdiction over specialized program areas has the prerogative of specifying a level of language proficiency as a collateral requirement for major fields. Students who are required to evidence intermediate proficiency as a collateral requirement of their major studies and individuals who desire to present official evidence of language proficiency for purposes of employment or application to graduate schools may satisfy intermediate language proficiency through any one of the following options:

- a. a score of 550 or above on a College Entrance Examination Board Achievement Test;
- b. a score of 3 or above on a College Entrance Examination Board Advanced Placement Examination;
- c. a satisfactory score in a proficiency test prepared and administered by the Language Department of the University

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of Massachusetts Lowell (preferably during the student's freshman year) and covering a reading knowledge of any one of the following languages: French, German, Greek, Italian, Latin, or Spanish;

- d. passing two semester courses on the intermediate, second-year college level in a language previously studied in the secondary school and offered by the University of Massachusetts Lowell; or
- e. passing a minimum of 12 semester credits in one language, the study of which is initiated at the University of Massachusetts Lowell.

Cooperative Education

The Cooperative Education Program integrates academic studies with productive work experience in business and industry and is available to all individuals whose major departments have agreed to permit their students to participate in an alternating schedule of study and work. Since students generally are placed in employment related to their academic fields of study, the Cooperative Education Program not only provides a source of income which may help students to defray their college expenses, but also tends to make classroom work more immediately relevant by clarifying career goals through personal experiences.

Full participation in the Cooperative Education Program ordinarily implies extension of the normal period of baccalaureate study to five years, and requires individual commitment to a 40 hour work week during assigned working periods. A maximum of three semester credits per working period (up to a total of nine credits) may be granted to participating students upon authorization of appropriate major departments. Depending upon departmental policies, these credits may satisfy unrestricted elective course requirements.

When on cooperative education assignment, a student remains registered at the University by means of required seminars and is required to pay all established fees. Additional information concerning the requirements for program participation may be secured from the Office of Cooperative Education.

Undergraduate Classification

Irrespective of the provisions of specific curricula and the number of full-time semesters completed by students, the University determines class standing on the basis of total credits earned (including AFROTC credits) and in accordance with the following scales:

Freshman standing	0-24 credits
Sophomore standing	24-54 credits
Junior standing	54-84 credits
Senior standing	84 or more credits

Maximum Period of Baccalaureate Study

Depending upon the nature of the subject and discipline, courses taken by a student may become obsolete for curricula of the University when they have been completed over a period of time which exceeds the customary period for baccalaureate study. Accordingly, University departments reserve the right to delete courses from a student's program of study when such courses have been determined to be obsolete for the curriculum in which the student is enrolled.

Ten full-time semesters is the period which is normally permitted for continuous University matriculation unless special permission for additional semester enrollment has been granted by the dean of the college in which a student is enrolled as a degree candidate. A student who fails to complete degree requirements within ten full-time semesters may be dropped from the University when instructional resources render it necessary to establish limitations upon enrollments.

Course Equivalency Examinations

The University recognizes two types of course equivalency for which credit is awarded. These are 1) CLEP examinations, and 2) departmental examinations. Restrictions, where applicable, are noted below.

Subject to specified policies of academic departments, unusually qualified degree candidates are given the opportunity to demonstrate their special competencies and to receive University credit for such

competencies through established course equivalency procedures without having to fulfill classroom or faculty course requirements. Matriculating students may demonstrate their special competencies through subject examinations of the College Level Examination Program and/or through departmental equivalency examinations. Credits which are granted through course equivalency procedures are noted on the student's permanent record card. However, no grades for equivalency examinations are recorded and such examination credit as may be granted is not computed for determining grade-point averages.

The purpose of course equivalency procedures is to provide credit for existing competencies—that is, those competencies which students possess prior to their applications for equivalency credit and prior to their registration for a University course.

Students may not receive credit for a specific proficiency examination if they have registered at the University in the course which that examination represents, if they have previously received a University grade for that course or a course in sequence above the course for which they wish to take the examination, or if they have previously attempted an equivalent course at another institution.

University departments reserve the right to refuse the granting of credit by examination for those courses which are presented by a student for his or her major(s) and to deny recognition of previously granted credit for students who, prior to their declaration of major field, have received equivalency credit in the subsequently declared major.

Subject to the additional limitations of the college and program in which the student is enrolled, the maximum number of credits which a matriculating student may earn through course equivalency procedures is 30 semester credits.

Students who have transferred to the University may not apply for equivalency credit in excess of a number which is determined by subtracting all course equivalency and transfer credits which are accepted by the University from the maximum of 90 credits which is permitted for

University Commencement

both transfer and equivalency credit. Nor may transfer students present equivalency credits in fulfillment of the major field residency requirement of 15 credits in University courses or the general residency requirements of 30 credits in University courses (cf. "Residency Requirements").

College Level Examination Program (CLEP)

Students who are interested in taking subject examinations of the College Level Examination Program should secure petition forms from the Office of Enrollment Services which will permit matriculating students of the University to arrange for administration of CLEP tests. Approved forms must be filed with the Office of Enrollment Services.

Application to take approved subject examinations of the College Level Examination Program may be made at the Division of Continuing Education or other CLEP testing centers. CLEP tests are administered at the University during the third week of each month. Course credit through the subject examinations of CLEP will be granted only if an examination has been approved by an individual's faculty advisor and the chairperson of the department which offers the course for which the CLEP test is a substitute and the score attained by the individual is equal to or better than the minimum score for an examination specified in the table below.

Although students are advised to secure the above authorization prior to taking a CLEP test in order to avoid rejection of a request for credit after a test has been taken, such authorization may be solicited after completion of a test. CLEP tests in subjects not listed below will not be recognized for University credit. The following is a list of CLEP tests for which credit will be granted.

	test score	earned credit
Accounting, Introductory	47	6
American Education, History of	46	3
American Government	47	3
American History	46	6

American Literature	46	6
Biology, General	46	6
Business Law, Intro	51	3
Calculus, Elem Functions	47	6
Chemistry, General	47	6
College Algebra	45	3
College Algebra & Trig	45	3
College Composition	47	3
College French (1 & 2)		
Second Semester	41	6
Fourth Semester	53	12
College German (1 & 2)		
Second Semester	40	6
Fourth Semester	48	12
College Spanish (1 & 2)		
Second Semester	41	6
Fourth Semester	50	12
Comp & Data Process	47	3
Computer Programming		
Elementary - FORTRAN IV	48	3
Educational Psychology	46	3
English Literature	46	6
Human Growth & Dev	45	3
Lit - Analysis & Interp	49	3
Macroeconomics, Intro	48	3
Microeconomics, Intro	47	3
Psychology, General	47	3
Sociology	48	3
Trigonometry	50	3
Western Civilization I	50	3
Western Civilization II	50	3

Departmental Examinations

Students who are interested in taking departmental examinations may obtain applications for such examinations from the Office of Enrollment Services at any time during the fall and spring semesters, but they must initiate the application process in sufficient time to permit the completion of examinations and the pro-

cessing of examination results prior to the final deadline for filing course grades during the semester in which they are examined. Applications for departmental course-equivalency examinations are filed with the chairperson of the student's major department, the chairperson of the department in which the examination is to be administered, and the faculty examiner.

Students may not repeat departmental equivalency examinations and, except for documented medical reasons or personal emergencies, they may not reapply for such examinations in the event that they fail to keep an examination appointment. Examinations must be wholly or substantially written unless the nature of the course makes more appropriate an oral or performance examination. Departments may authorize instructors to administer end-of-semester examinations which are scheduled during the final examination period when such examinations are adequate measures of total course requirements. After the student has completed an authorized examination, the faculty examiner must file his or her recommendation for course credit with the Office of Enrollment Services by the final deadline for filing semester grades.

Programs of Study and Declarations of Intent to Graduate

All students are required to file with their advisor a copy of their final semester course registrations (including notification of course withdrawal) and an accurate account of courses taken, grades received, and changes of contemplated programs of study. Deadlines for conferring with faculty advisors concerning the completion of degree requirements and for filing final programs of study and declarations of intent to graduate with college deans are specified by the University calendar.

Each college has adopted a program of studies form which best reflects the nature of its degree programs. Forms which are employed by the College of Arts and Sciences and the College of Health Professions have been standardized and designate three areas: University general education requirements, major requirements, and collateral programs (second majors, minors, and unrestricted elective courses).

Credits for each course may be counted only once in a student's program of studies form and may not be counted for more than one category of the program of studies (courses and credits in the human values requirement of the general education requirement may be used to fulfill this requirement and another requirement in the student's curriculum but may not be counted twice in satisfying the overall credit hour requirement for the curriculum). A course which is specified as a requirement for both a student's major and minor will satisfy both requirements, as stated, but course credits may not be counted more than once and may be applied to one category of a student's program of studies only.

At the end of the semester following the filing of a declaration of intent to graduate, the college dean verifies course completions and required cumulative and major averages. The names of students who have satisfied all degree requirements are then forwarded to the appropriate college faculty for endorsement and, finally, to the Office of Academic Affairs, which orders appropriate diplomas for conferral at graduation. Students who unofficially complete all degree requirements and fail to file a declaration of intent to graduate or a program of studies shall not be recommended to the Office of Academic Affairs and the conferral of the degree shall be delayed until an approved declaration has been filed.

University Commencement

Graduation exercises are held once a year at the end of the spring semester. Undergraduates who have completed degree requirements during the previous summer term or fall semester are permitted to attend commencement exercises and their names are listed in the commencement booklet. Attendance of commencement exercises is not compulsory, but all seniors are required to pay the specified graduation fee, which covers the cost of the diploma, academic attire, and incidental graduation expenses. An individual who wishes to receive a diploma by mail must file a corrected address with the Office of Enrollment Services if he or she anticipates moving from a previously reported permanent address.

Conferring of Degrees

Diplomas are awarded three times a year: 1) in June for students completing degree requirements during the spring semester, 2) in October for students completing degree requirements during the summer term, and 3) in February for students completing degree requirements during the fall semester. Individuals who wish to submit verification of degree completion to employers or to graduate schools during the period between the end of their final grading period and the awarding of diplomas may obtain a letter of completion from their college dean. Duplicate diplomas are not issued for any reason.

Academic Honors

Academic honors are of three types: University honors, honors in major fields, and dean's list (semester honors). Undergraduate students may qualify for University honors and the dean's list. Honors in major fields are available at the option of the major departments.

University Honors

The University recognizes baccalaureate graduates who have attained exceptional scholastic distinction. To be eligible for such recognition a student must achieve a minimum grade point average of 3.00 for all courses completed at the University and must have earned a minimum of 60 semester credits at the University as upperclass students. Additionally, each student must achieve a grade-point average which falls within the range of averages specified by each college for the levels of distinction.

Three levels of distinction are noted at commencement: *summa cum laude*, *magna cum laude*, and *cum laude*.

University honors are officially entered on the permanent record of students.

Honors in Major Fields

In addition to honors which are awarded by the University, honors in major fields may be awarded by the colleges in which students are enrolled or (in the case of continuing education students) by the colleges which exercise academic jurisdiction over the program in which they are

enrolled. Recommendations for such honors are made by the faculty of the student's major department (or by interdisciplinary committees which exercise academic jurisdiction over the student's major studies) for outstanding achievement in the major field. In order to qualify for such honors, the student must fulfill the following requirements:

- a. complete a minimum of 24 credits in the major field at the University of Massachusetts Lowell;
- b. fulfill any honors requirement as specified by colleges, departments, or interdisciplinary committees in the major field; and
- c. achieve a grade-point average as specified below.

High Honors

4.00 in all courses which are taken in the major field at the University of Massachusetts Lowell.

Honors

3.50 to 3.99 in all courses which are taken in the major field at the University of Massachusetts Lowell with no course grade in such courses less than B.

Honors in the major field are not noted on the permanent record cards of students.

Dean's List (Semester Honors)

At the end of the fall and spring semesters, the dean of each college issues a list of undergraduate students who have achieved distinguished semester records. This list recognizes students who have completed full-time programs (at least 12 credits of which must have been qualitatively graded) with no grade less than B.

*Grading Policies***Grading Policies**

The following qualitative letter grades are employed by faculty members to characterize the quality of a student's work in a course: A, AB, B, BC, C, CD, D, and F and respectively carry quality points of 4.00, 3.50, 3.00, 2.50, 2.00, 1.50, 1.00, and 0.

- A designates that the work done by the student is superior and is of the highest honors quality;
- AB designates that the work done by the student is less than superior but is completed with the level of distinction which is higher than the basic honors level;
- B designates that the work done by the student is of basic honors quality;
- BC designates that the work done by the student is less than honors quality but is better than satisfactory;
- C indicates satisfactory work which conforms to the general expectations of the University for baccalaureate study;
- CD indicates that the work done by the student is less than satisfactory and below graduation standard but is better than the minimum requirement for passing a course;
- D indicates work which meets the minimum requirement for passing a course;
- F designates course failure.

In addition to the above qualitative letter grades, the following symbols are used to designate special enrollment provisions or course statuses and do not affect the student's academic average:

- P designates completion with credit of an unrestricted elective or physical activities course which was taken on a pass-no credit basis;
- NC indicates failure of an unrestricted elective which was taken on a pass-no credit basis;
- S designates satisfactory completion of a practicum experience course with a final course grade of C or higher;
- U indicates unsatisfactory performance in a practicum experience course with a final course grade of less than C;
- I indicates a course which has not

been completed;

- AU designates that the student has registered for a course on an audit basis and has maintained an attendance record throughout the semester which is sufficient to warrant an official recognition of course attendance;
- W designates student withdrawal from the University prior to the 51st class day of a semester or from a course during the period from the 10th to the 50th class day;
- X designates withdrawal after the 50th class day of a semester for administratively approved reasons of an emergency or medical nature; and
- Y designates administrative dismissal for other than academic reasons.

Pass-No Credit Course Registration

Students may elect to register on a pass-no credit basis for a maximum of four unrestricted elective courses. A student may not change his or her enrollment status from letter grade to pass-no credit or from pass-no credit to letter grade after the established deadline for adding a course. A pass-no credit course cannot be presented in fulfillment of University General Education requirements, major programs, minor programs, or specifically designated courses (collateral requirements) of an established curriculum. A grade of P indicates that a student's performance merits an evaluation of D or better. NC indicates that a course has been failed but that such failure is without prejudice to the student's cumulative average. Although appropriate credits are granted to students when grades of P have been assigned, these credits are not qualitatively weighted and hence do not affect a student's academic average. The entry NC will not keep an otherwise qualified student from dean's list recognition.

Satisfactory-Unsatisfactory Course Registration

Certain courses (e.g., practicum experiences, advanced seminars, and directed studies) may be graded as satisfactory or unsatisfactory. A grade of S indicates that a student's performance merits an evaluation of C or better. U indicates a course evaluation of less than C. Although appropriate

credits are granted to students when grades of S have been assigned, these credits are not qualitatively weighted and hence do not affect a student's academic average. A grade of U indicates that attempted course credits have not been granted and is awarded without prejudice to a student's cumulative average.

Incomplete Courses

The letter symbol I (incomplete) is a temporary notation which is assigned for incomplete work in courses when the records of students justify the expectation that they will obtain a passing grade but for emergency reasons they have been absent from the final course evaluation. Any missed final examination or other final course evaluation requires a student explanation within 48 hours so that the instructor can file the proper course notation with the Office of Enrollment Services. A student who has evidenced an unsatisfactory course record, who has failed to complete a major portion of an instructor's course requirements, or who fails to provide an instructor with a satisfactory reason for absence from a final examination or final course evaluation within the specified 48 hour period may not be assigned the letter symbol I.

Responsibility for making arrangements with an instructor to complete all outstanding course work rests entirely with the student, who must complete all course work in sufficient time to permit an instructor to file a final course grade no later than one month after the date on which the succeeding semester begins.

Instructors who file letter symbols of I also must file an end-of-course letter grade which will be assigned in the event that incomplete course work is not made up by the student prior to the established deadline. At the end of the official make-up period (or, in the event of a substantiated student emergency, at the end of an extended make-up period), the Director of Enrollment Services will convert the temporary notation of I to the appropriate permanent symbol. This permanent notation will be one of the following: 1) a letter grade which has been filed by an instructor during the grading period of the previous semester to designate the final course standing of a student who has failed to make up incomplete course requirements,

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Withdrawal from the University

2) a letter grade which is filed by an instructor at the end of the make-up period to designate the final course standing of a student who has made up incomplete course requirements, or 3) the letter symbol of X which the dean of the college in which the student is enrolled as a degree candidate may authorize to designate that a student has withdrawn from the University after the end of the semester for documented medical or personal emergency (cf. "University Withdrawal After the End of the Semester").

Limited extensions of the make-up period may be granted to students for serious medical reasons and for documented personal emergencies. Requests for such extensions are approved by the dean of the college in which students are enrolled as degree candidates and must be filed no later than one calendar week preceding the established deadline for instructors to submit final grades for incomplete courses. Except for extraordinary circumstances acceptable to a college dean, the maximum period for which an extension may be granted is the last scheduled class day of the semester following the assignment of I notations.

Audited Courses

A student may enroll in credit courses as an auditor with appropriate approval. Forms and instructions for registration as an auditor may be obtained from the Office of Enrollment Services. No charge is levied on full-time students for audited courses. No credit or grade will be recorded for an audited course, but the symbol AU will be listed on the permanent record card. A change from audit to credit status, or from credit status to audit, may not be made after the deadline for adding a course (tenth class day).

Credit may not be earned in courses which have been audited except by re-enrollment in and completion of the course with a passing grade. Students who have audited a course subsequently may not earn credit in the same course through tests of the College Level Examination Program or through other authorized examination procedures for course challenge.

Grade Changes

At the end of each semester, the Office of Enrollment Services mails a grade report to each student. This report constitutes official notification of grades received. All course grades become a part of the student's official record upon instructor assignment and may not be changed except as specifically provided by University procedures. Corrections of grade-point averages automatically are authorized when erroneous grade reports are corrected by instructors and when specific courses are deleted from grade-point averages under provisions of University regulations governing repeated courses and course deletions.

Students who believe that a mistake has been made in assigning or recording a course grade should notify instructors as soon as possible after receiving their grade reports but in no case at a time later than the deadline established for making grade corrections. The deadline for instructors to correct an erroneous grade report is one calendar month from the beginning of the semester following the filing of an erroneous grade. Changes of grades other than the filing of grades for incomplete courses require the endorsement of the appropriate college dean. Grade changes may not be made on a student's permanent record card after the deadlines cited above unless such changes have been authorized by appropriate college deans prior to the expiration of the correction deadline. Accordingly, students who experience difficulty in contacting faculty members for the purpose of questioning assigned grades should consult the appropriate college dean prior to the expiration of the correction deadline.

Withdrawal from Courses

W and X are administrative symbols which indicate that a student has been authorized to withdraw from courses, or from the University. These symbols, which are entered upon the student's permanent record card without prejudice, may be authorized only in accordance with established policies of the University and only upon student request.

Course Withdrawal Through the 50th Class Day

Students who desire to withdraw from courses with notations of W during the period from the 11th to the 50th class day of a semester must file these forms with the Office of Enrollment Services no later than the 50th class day. Students who do not complete the process of withdrawal by the 50th class day will not be assigned course notations of W, will be subject to all instructor course requirements, and will receive final course grades. Since such unforeseen circumstances as late trains, automobile breakdowns, and faculty absences unexpectedly may extend the period during which a student has planned to complete the withdrawal process, a student who delays his or her course withdrawal until the end of the withdrawal period may discover that it is impossible to comply with the withdrawal deadline of the 50th class day.

Students who withdraw from all courses are required to withdraw from the University. Students receiving benefits from the Veterans Administration are not permitted to reduce their course loads below the full- or part-time levels which they have reported to the Veterans Administration.

Course Withdrawal After the 50th Class Day

Course withdrawal after the 50th class day of a semester ordinarily requires withdrawal from the University but partial withdrawal may be authorized for reason of extended illness or critical personal emergency.

1. The student shall present an academic petition to the dean of the college in which the student is enrolled which identifies the course(s) from which the student seeks to be withdrawn.
2. Along with the petition, the student shall present appropriate, verifiable documentation which is corroborative of the reason for withdrawal advanced on the petition.
3. Partial withdrawal will not be authorized because a student anticipates a low or failing grade in the course or because of the presumed effect of a low or failing grade on the student's cumulative grade-point average.

Administrative Dismissal from the University

4. The student who fails to complete course withdrawal procedures before the first day of the final examination period will be denied permission to withdraw from a course and accordingly will be graded. Exceptions to this policy may be granted for verified extraordinary circumstances by the Associate Provost.

Students receiving benefits from the Veterans Administration are not permitted to reduce their course loads below the full- or part-time levels which they have reported to the Veterans Administration.

Withdrawal from the University

All students who desire to withdraw from the University are required to 1) discharge all financial obligations to the University, 2) return all University property, and 3) file a written notification of withdrawal with the Office of Enrollment Services.

Since the date of official withdrawal as recorded by the Office of Enrollment Services is one basis of any claim for tuition refund, and may be of importance in determining subsequent legal or student insurance claims, students should process withdrawal papers in person prior to leaving the University. Students who absent themselves from the University without officially withdrawing will remain on class rosters until they officially withdraw from the University or until the end of the semester.

Students who remain on class rosters after the 50th class day will be assigned final course grades. The date on which a withdrawal request is filed with the Office of Enrollment Services is the date on which withdrawal is academically effective and constitutes the basis for final course notations.

The names of students who have withdrawn from the University for any reason are removed from all rolls. Students who have withdrawn must be reinstated. This is accomplished only through the office of admissions.

Students who are recipients of benefits from the Veterans Administration may not process withdrawals from the University which violate their declarations of class-

room attendance. Recipients of veterans benefits are advised that they must receive course grades when their requests to withdraw from the University have been filed after deadlines of the Veterans Administration for processing changes of declared benefit status or when their dates of withdrawal will conflict with declarations of classroom attendance.

University Withdrawal Through the 50th Class Day

Students who register for courses and who withdraw from the University prior to the first day of classes of a semester are withdrawn without record. Students who register for courses and who withdraw from the University from the 1st to the 50th class day of a semester are withdrawn with course notations of W.

University Withdrawal After the 50th Class Day

A student who withdraws from the University during the period from the 51st class day to the end of the semester must be graded by all course instructors unless the student is authorized to withdraw for documented reasons of extended illness or critical personal emergency. A student who wishes to withdraw temporarily or permanently from the University after the 50th class day of a semester for such reasons must file an academic petition, together with appropriate documentation, with the Associate Provost. Following a review of the academic petition and verification of attached documentation, the Associate Provost may permit the student to withdraw from all courses.

University Withdrawal After the End of the Semester

A student who has unofficially withdrawn from the University (i.e., has ceased attending classes) for reasons of extended illness or critical personal emergency and (for reasons acceptable to the Associate Provost) has been unable to officially withdraw from the University before the end of the semester may petition to withdraw from all courses with symbols of X. Such a student must file an academic petition, together with supporting documentation,

no later than one calendar month from the beginning of the following semester. This petition must be filed with the Associate Provost, who will decide if the petition may be approved.

A student who has been the recipient of benefits of the Veterans Administration may petition to withdraw from the University after the end of the semester only when he or she has been provided with written authorization from the Veterans Administration.

Administrative Dismissal from the University

A student may be administratively dismissed from the University through cancellation of registration for due cause, through suspension or expulsion for academic dishonesty (cf. "Academic Dishonesty, Cheating, and Plagiarism"), and through disciplinary procedures for violations of good conduct. For information concerning procedures which govern violations of campus conduct, refer to the section "Student Disciplinary Procedures" in this catalogue.

Administrative dismissal may be invoked when a student fails to comply, after due notice, with an administrative regulation of the University. Official notification of an administrative dismissal is noted on the permanent record card by the symbol Y, which is entered for each course which has been carried by the dismissed student. Reinstatement of a student who has been administratively dismissed may be made only by application for readmission with the Office of Admissions and only when the condition which has necessitated administrative dismissal can be ameliorated to the satisfaction of the University officials. Examples of some conditions which may justify administrative dismissal are as follows:

- a. forgery or fraudulent use of University records, documents, or forms; unauthorized entry into University records (including computerized records);
- b. non-payment of tuition, board, room charges, student fees, library fines, overdue University loans, and other official University fiscal obligations;

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- c. failure to comply with a duly authorized administrative order relating to the safety of persons or the protection of University property;
- d. failure to submit necessary health forms as required by University Health Services; and
- e. failure to withdraw from the University after certification of a physical health or mental health condition of a hazardous nature.

Academic Dishonesty, Cheating, and Plagiarism

Definitions of Academic Dishonesty & Prohibited Academic Practice and Behavior

The following definitions are provided for the information of all students and constitute official notice of prohibited academic practice and behavior.

1. Cheating is defined as 1) misrepresenting academic work which has been done by another as one's own efforts—whether such misrepresentation has been accomplished with or without the permission of the other individual, 2) providing or utilizing prohibited assistance (whether in the nature of a person or a resource) in the performance of assignments and examinations, 3) copying of another person's work or the giving or receiving of information or answers by any means of communication during an examination, 4) utilization of the services of a commercial term paper company, and 5) the unauthorized or fraudulent acquisition and/or use of another's academic property.
2. Plagiarism is defined as 1) direct quotation or word-for-word copying of all or part of the work of another without identification or acknowledgment of the quoted work, 2) extensive use of acknowledged quotation from the work of others which is joined together by a few words or lines of one's own text, and 3) an abbreviated restatement of someone else's analysis or conclusion, however skillfully paraphrased, without acknowledgment that another person's text has been the basis for the recapitulation.

Obligations of Faculty Members to Students

Although each student is responsible for complying with the above notice of prohibited practice and behavior, faculty members are responsible for publishing their special requirements for completing assignments and taking examinations. Such requirements must be explicitly made through the published statement of course requirements or through examination and assignment directions.

Preservation of the integrity of the academic process is an exercise of professional judgment and is both a faculty right and a faculty duty. The rendering of a professional judgment when charging or adjudicating an academic offense must be honest and equitable and must ensure due process, including notification to the student of the particulars of a charge of academic dishonesty and the penalties which will be imposed or recommended.

In assessing penalties for academic dishonesty or prohibited academic practice and behavior, faculty members and designated authorities of the appeal process should consider the nature of the offense, the question of premeditation, and any previous record of dishonesty or violation of prohibited practice and behavior. Neither the student nor the University can be served when the punishment is not proportionate to the offense.

Process of Notification and Adjudication

Depending upon the circumstances of time and place when academic dishonesty has been detected and the severity of penalty which the faculty member wishes to impose, notice to the student concerning alleged dishonesty and/or violation of prohibited academic practice and behavior may be provided through either a formal or informal procedure. Should the faculty member* fail to notify the student of a charge of academic dishonesty and/or prohibited academic practice and behavior through either an informal verbal notification of charges or a formal written notification of charges, no penalty may be imposed.

*When a faculty or department committee is responsible for evaluating student work

for a course (e.g. Senior Studio Review Committee, Department of Art), instructor notification shall be provided by the committee chairperson.

Informal Procedures

The informal notification procedure may be used only in the following instances: 1) in cases of observed cheating or observed violation of testing or classroom assignment requirements; 2) in cases of reported cheating or violation of classroom testing or assignments, detected plagiarism, or other cases occurring prior to the final examination in which the commissions and detection of academic dishonesty are not coincident; and 3) in cases for which the recommended penalty, per se, is less than course failure.

The informal notification procedure may not be used for offenses which are detected during or after the administration of the final course examinations or (in the event that no final examination is administered) after the last class of a semester and may not be used if the faculty member wishes to impose penalties which range from course failure to suspension from the University.

In cases of observed cheating, the informal procedure includes verbal notification to the student prior to the end of the examination or class period and appropriate written comment on the student paper which shall include a statement of the penalty to be imposed. In those cases wherein the commission and detection of academic dishonesty are not coincident, the faculty member shall provide notification by making an appropriate written comment on the paper or assignment which shall include a statement of the penalty to be imposed.

Within three class days of notification, the student may request a meeting to discuss the charge and the penalty specified, and the faculty member shall schedule such meeting. The purpose of the informal meeting is to clarify possible misunderstandings between the student and the faculty member, to discuss the impact of the proposed penalty upon the student's final grade, and to pursue any question relative to the charges and penalties. At this meeting, or within three class days of this meet-

*Penalties for Academic Dishonesty or
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ing, the student shall advise the faculty member that he or she accepts the charge and penalty proposed or that he or she will initiate a formal appeal with the department chairperson. If the student does not initiate a formal appeal, the charge may not be challenged and the penalty may not be appealed. In the event that a formal charge of academic dishonesty is initiated by a department chairperson, the chairperson shall be replaced in all stages of the appeals procedure by a senior faculty member of the department in which the violation is alleged to have occurred.*

*In the event that all members of the department have served on the department committee which has initiated charges against a student and the chairperson of such department committee also is the chairperson of the department, the appeal process shall begin with the academic standards committee.

Formal Procedures

The formal procedure for notification and adjudication must be used in the following instances:

- 1) in cases of observed cheating or violation of testing procedures during the final examination;
- 2) in cases of cheating or plagiarism which are detected after the final examination; and
- 3) in cases for which the recommended penalty ranges from course failure to expulsion.

In each of the above cases, the faculty member shall provide the student with formal written charges of alleged dishonesty or violation of prohibited academic practice or behavior. During periods when classes are in session, such charges either shall be given to the student in person or shall be sent to the student's campus mailbox. During periods when classes are not in session, such charges shall be sent to the student at his or her official home address of record by registered mail (return receipt requested). Notification shall be given to the student or mailed within three class days+ of the time when the faculty member became aware of the alleged student offense or by the last day for filing semester grades with the Office of the Registrar,

whichever is earlier. A copy of written charges shall be forwarded to the department chairperson, the chairperson of the college academic standards committee, and the college dean.#

+The term "class day" is defined as any day when classes and final examinations are scheduled. It also applies to days when University offices are open during the week which immediately precedes the first scheduled day of semester classes. In extraordinary circumstances, the college dean may authorize extensions of deadlines and may authorize the scheduling of hearings during periods other than the regular academic year.

#The terms "department chairperson," "college dean," and "college academic standards committee" refer, respectively, to the designated officials and committee of the college in which the concerned course is offered.

A formal adjudication of a charge of academic dishonesty also may be initiated by a student on appeal from the procedure of informal adjudication and discussion. In such case, the faculty member shall provide a formal written statement of charges to the student, the department chairperson, the chairperson of the college academic standards committee, and the college dean within two class days of the student's notification of intent to appeal.

Within seven class days of receipt of a formal notification of academic dishonesty, the department chairperson shall hold a meeting with the faculty member and the student to discuss the charges and recommended penalty. At the end of the meeting, the department chairperson shall notify the parties of his or her judgment. If there is no further appeal, the chairperson's decision shall be final.

Either the student or the faculty member may appeal the chairperson's decision to the college academic standards committee. This appeal must be made within three class days of the chairperson's decision. The academic standards committee shall meet with the department chairperson, the faculty member, and the student within seven class days of receipt of requested appeal. Within three class days, the committee shall notify the concerned parties of its decision.

If there is no further appeal, the committee's decision shall be final.

Either the student or the faculty member may appeal the decision of the college academic standards committee to the college dean. This appeal must be made within three class days of the committee's decision. The college dean shall meet with the chairperson of the college academic standards committee, the department chairperson, the faculty member, and the student within seven class days of the requested appeal. Within three class days, the college dean shall notify the concerned parties of his or her decision. The decision of the college dean shall be final and, hence, may not be appealed.

Right of Student Counsel at Hearings

A student who has been formally charged with an academic offense may request representation from the Office of Student Services, the counseling staff, or the full-time faculty to provide aid and assistance at any stage of formal hearings. Such counsel shall be provided with copies of documents which have been forwarded to hearing authorities and he or she shall be present for all formal hearings. Legal counsel may be present for either the student or the University but may not participate in hearing deliberations.

Special Provisions

While an appeal process concerning an academic offense remains unresolved, the charge shall not prejudice the right of a student who has not otherwise been suspended for unsatisfactory academic performance or student misconduct from continuing his or her course of study at the University.

The timetables which have been specified above for the conduct of appeal processes have been developed to insure the speedy resolution of both the charges and the student's University status. In the event that resolution of a charge of academic dishonesty cannot be made prior to the beginning of next semester and a charge of academic dishonesty is subsequently sustained and the penalty imposed either requires or results in suspension, the student shall be dropped from the University immediately

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and accordingly may not be permitted to complete courses for which he or she may have registered.

A party to an appeal hearing who is unable to attend his or her hearing as scheduled must notify the appeal authority as soon as possible, preferably one day in advance. An individual may be excused from attendance and may be granted a second hearing for good and sufficient reason acceptable to the appeal authority.

Except that the penalty of suspension or expulsion from the University shall require the concurrence of the college dean, an appeal authority at any level may resolve a charge of academic dishonesty and/or may impose a penalty without recourse to subsequent hearings, if, without prior notice, the appealing party has failed to appear as scheduled for an appeal hearing.

A party of an appeal hearing who was unable to provide prior notice of his or her inability to attend an appeal hearing as scheduled may submit an academic petition to the college dean requesting a rehearing before the appropriate authority. The college dean may grant a rehearing for reasons of serious illness, accident, critical personal or family emergency, or other such acceptable reasons, and his or her decision concerning a rehearing shall be final.

Penalties for Academic Dishonesty or Prohibited Academic Practice and Behavior

Except as noted below, penalties for academic dishonesty or prohibited academic practice and behavior which are adjudicated through the informal procedure are limited to 1) the administration of an alternate assignment or substitute examination which shall be at the sole discretion of the faculty member, and 2) failure of an examination or assignment and denial by the faculty member of permission for the student to withdraw from the course before the 50th class day.

Penalties for academic dishonesty or prohibited academic practice and behavior, which are adjudicated through the formal procedure (including cases appealed by the student from an informal adjudication), may range from the administration

of an alternate assignment or substitute examination at the sole discretion of the faculty member, failure of an examination or assignment (and the consequent lowering of final course grade) through course failure (including denial of permission to withdraw from the course in question before the 40th class day) to academic suspension or dismissal from the University.

The penalty of academic suspension, which may be imposed for a new semester or academic year, and the penalty of dismissal from the University (expulsion), which shall be permanent, may be imposed only by the college dean. In the event that the dean of the college in which an academic offense has taken place shall approve or impose either a penalty of academic suspension or dismissal (expulsion) from the University upon a student who is matriculating for a degree in a college other than that in which the academic offense has taken place, the imposition of such suspension or dismissal shall require the concurrence of the dean of the college in which the student is matriculating. If the deans do not concur, they shall arrive at a mutually agreeable penalty and such decision shall be final.

The semester grade filed by a faculty member for a student who is the subject of an unresolved or pending allegation of academic dishonesty shall be an Incomplete, with an end-of-course letter grade which shall be assigned in the event that the student makes no appeal or the charge is sustained through appeal and the penalty is reaffirmed. If the determination of penalty which is made at the last step of the appeal process, as invoked, is different from that which was initially made, the faculty member shall file a correction of the final grade which is in compliance with the final determination.

Special Procedure for Penalties Relating to Legal Professional Licensure and/or Certification

The implication of academic dishonesty or violation of prohibited academic practice and behavior for ethical standards which are specified by law for professional licensure and/or certification are questions which properly reside with professional review bodies. Hence, a decision concern-

ing student continuance or discontinuance in a professional program which requires legal licensure or certification shall not be made by an individual faculty member or by designated authorities of the appeal process defined above.

Following the imposition of a penalty by a faculty member or by designated authorities of the appeal process defined above for academic dishonesty, the status of a student who is enrolled in professional program which requires legal licensure or certification may be reviewed by an established professional review body. If, in the opinion of the professional review body, the nature of the academic violation warrants discontinuance of the student's enrollment in the professional program, it shall so notify the student, who either shall withdraw or shall be dropped from the professional program. The decision of a professional review body is final and may not be appealed to the college dean.

Academic Standing

Academic standing and eligibility for a degree are determined by the quality of the student's course work.

Determination of Academic Standing

To ascertain the student's academic standing, the University uses a point system, each qualitative grade having an equivalent numerical value.

A	=	4.00
AB	=	3.50
B	=	3.00
BC	=	2.50
C	=	2.00
CD	=	1.50
D	=	1.00
F	=	0.00

Quality points are computed by multiplying the number of course credits by the numerical value of the qualitative grade assigned. For instance, a three-credit course with a grade of BC would carry 7.50 quality points (3 x 2.50). Grade-point averages and cumulative grade-point averages are obtained by dividing the

Academic Standing

number of quality points earned by the number of quality hours attempted.

Specified grade-point averages are computed solely on the basis of those courses attempted at the University of Massachusetts Lowell which have been qualitatively evaluated with the following letter grades: A, AB, B, BC, C, CD, D, and F.

All students are required to maintain at least a 2.00 average throughout their academic career. Academic records are evaluated at the end of each semester. No student, however, will be academically suspended without having at least one semester of academic notice or academic warning. The academic status of a student is one of the following six categories:

Satisfactory Academic Standing

Indicates that the semester grade-point average is at least 2.00, and the cumulative grade-point average is at least 2.00.

Academic Notice

Indicates that: a) the semester grade-point average is less than 2.00 but the cumulative grade-point average is at least 2.00; or b) a "low-credit student" (one who has attempted fewer than 21 credit hours) has a cumulative grade-point average of at least 1.70 but less than 2.00.

Academic Alert

Indicates that a low-credit student (one who has attempted fewer than 21 degree credits) has a cumulative grade-point average below 1.70.

Academic Warning

Indicates either: a) the cumulative grade-point average is below 2.00; or b) the semester grade-point average is below 2.00 but the cumulative grade-point average is at least 2.00, and the student had been on Academic Notice, Alert, or Warning at the end of the previous semester.

Academic Suspension

Indicates that the student was on academic notice or warning at the end of the previous semester and the cumulative grade-point average is below 2.00.

Academic Probation

Indicates that the student was readmitted after an academic suspension.

Academic Dismissal

Indicates that a student was on academic probation and failed to achieve satisfactory academic standing during the probationary semester.

Changes in Academic Standing

1. A student who has been in satisfactory academic standing and whose semester grade-point average is less than 2.00 but whose cumulative grade-point average is at least 2.00 is placed on academic notice.
2. A student who has been in satisfactory academic standing and whose semester grade-point average is less than 2.00 and whose cumulative grade-point average is less than 2.00 is placed on academic warning.
3. A low-credit student whose cumulative grade-point average is at least 1.70 but below 2.00 will be placed on academic notice.
4. Regarding a student who has been on academic notice or on academic warning:
 - a) If the student's semester grade-point average and cumulative grade-point average are at least 2.00, the student will be in satisfactory academic standing.
 - b) If the student's semester grade-point average is at least 2.00 but cumulative grade-point average is less than 2.00, the student will be academically suspended.
 - c) If the student's semester grade-point average is less than 2.00 but cumulative grade-point average is at least 2.00, the student will be placed on academic warning.
 - d) If the student's semester grade-point average and cumulative grade-point

average are both below 2.00, the student will be academically suspended.

5. A student who has been re-admitted on academic probation but who does not satisfy the requirements of probation at the end of the probationary term is academically dismissed from the University.

Appeal of Suspension

Suspension may be appealed if and only if:

- a. the student has attempted at least 21 but less than 35 credit hours* and has a cumulative grade-point average greater than 1.70; or
- b. the student has attempted at least 35 but less than 69 credit hours* and has a cumulative grade-point average greater than 1.80; or
- c. the student has attempted at least 69 credit hours* and has a cumulative grade-point average greater than 1.90.

*Included in course hours attempted are all course credits which have been granted (including credits awarded through transfer and challenge by examination, course credits which have been awarded with qualitative letter grades, and credits attempted with notation of Incomplete or with nonqualitative grades of P and S) and all hours of course work which have been failed with the qualitative letter grade of F. Courses which have been failed and which carry the non-qualitative symbols of U and NC are not included in the computation of course hours attempted.

If eligible for appeal, a suspended student may submit a written appeal to the dean of the college in which the student is enrolled, requesting permission to continue enrollment in an additional semester of academic warning. The written appeal must include a proposed program of full-time study for the following semester, approved by the student's academic advisor. The student will be notified in writing of the decision of the dean. If permission to continue is granted, the program of study that must be undertaken and the minimum semester grade-point average that must be attained during the additional semester of academic warning will be detailed.

ACADEMIC POLICIES

Registration and Course Enrollment Policies

Entering freshmen and transfer students who are permitted to initiate their University studies with summer school courses should note that credits attempted in University summer sessions are included in calculations for the fall semester.

Entering students who have initiated their University studies in authorized summer school courses are not permitted to invoke the regulation concerning course repetition for the purpose of grade substitution prior to the initial evaluation of their records for retention purposes. Subsequent to initial evaluations for retention purposes, the records of all students (including probationary students) are evaluated at the end of each semester.

Students are permitted to use the January Inter-session and the summer programs in an attempt to improve their academic standing, with the exception that freshmen are not permitted to use the January inter-session to amend their academic standing for the spring semester.

Academic Probation

A student who has been suspended from the University is entitled to apply to the Office of Enrollment Services for readmission as a probationary student in accordance with procedures enumerated under the admission policy heading "Probationary Readmission." Students who are readmitted on probation will receive a letter from the appropriate academic standards committee which will specify the conditions of their probation, their probationary courses and the semester average which they must achieve during their probationary semester in order to achieve satisfactory academic standing.

Probationary students are prohibited from holding student offices or running for elective office and from representing the University in athletic or other activities.

A student who achieves the required minimum semester grade-point average during his or her probation is automatically reinstated as a student in satisfactory academic standing. A student whose semester grade-point average falls below that required by no more than 0.10 may be granted an extension of the probationary period for

one additional semester. Such extension of probation, if granted, will be made by the appropriate academic standards committee during the period between semesters.

Students who are granted such extensions will be notified in writing prior to the beginning of classes for the following semester that they have been granted an additional semester to achieve satisfactory academic standing. Students who fail to achieve satisfactory academic standing and are not granted extensions of their probations by the appropriate academic standards committees and students who are granted such extensions and fail to achieve satisfactory academic standing are dismissed from the University and are subsequently barred from attending both day and evening courses.

Students readmitted on probation may not withdraw from any course unless they obtain the permission of the college dean; such permission may be granted for reasons of emergency or for medical reasons.

Probationary students who receive course evaluations of I (incomplete) and who fail to make-up their work prior to the beginning of the next semester are advised that they may not qualify for extension of their probation and may not register for nor attend University courses (including continuing education courses) until such time as a final determination of their status has been made. Probationary students who have received permission of a college dean to extend their make-up period should understand that such extension does not waive the requirement for a final determination of academic standing which is based upon grades for all probationary courses.

Registration and Course Enrollment Policies

All students are required to register for courses during periods which are officially designated for registration and pre-registration unless they have been authorized to make other arrangements by the dean of the college in which they are matriculated. Non-matriculated students are permitted to enroll for course loads only as specified by their conditions of admission. Except for part-time students in the Encore pro-

gram, all matriculated students (including probationary students) must register for courses which comply with prescribed courses of study and must comply with the policies (below) concerning semester course loads and reduced load status.

Semester Registration

Students are required to register in person during the designated pre-registration and registration periods. Students have complied with the pre-registration requirement when they have had a schedule of lecture, recitation and laboratory work approved by their advisors and have filled in and processed the forms provided by the Registrar's office. They have satisfied the registration requirement when they have paid the required tuition and fees and have complied with the course drop and add process. Endorsements of instructors and advisors are required for each change of enrollment card which is filed. Students who pre-register for courses for which they subsequently fail to satisfy prerequisites must initiate changes of registration during the add-drop period. Students are not enrolled in classes for which they are not properly registered.

The Office of Enrollment Services mails copies of individual semester schedules to students at the mailing address on file in the Office of Enrollment Services. Students are advised that such mailing constitutes official notification from the University concerning each individual's record of course registrations.

Students who believe that errors have been made in their registrations should consult with the Office of Enrollment Services prior to the deadline for adding courses. Students who do not check their mail and accordingly fail to correct scheduling errors by established deadlines may not expect to have University regulations waived for their benefit.

Course Additions

Students who wish to add a course during the first ten days of classes may do so in person at the Office of Enrollment Services or by using the telephone Voice Response System.

*Repeated Coursework/Course Deletions***Dropped Courses**

A student who wishes to drop* a course may do so in person at the Office of Enrollment Services or, during the first ten days of classes, by using the telephone Voice Response System. There are only two cases for which a drop is not necessary:

1. if the course is cancelled by the University; or
2. if courses (or sections) carry no credit and will not appear on the permanent record card.

*Courses dropped during the first ten days of classes will not show on the permanent record. Courses dropped from the 11th to the 50th day of class will be assigned a grade of W and will appear on the permanent record.

Courses Cancelled by the University

Students are not required to drop courses or sections which are cancelled subsequent to pre-registration by the University. If students wish to replace a cancelled course with another, they must follow the above procedures for course additions.

Semester Course Loads

The typical course load expectation for full-time students is 15 credits. Professional curricula may specify credits in excess of this number, in which case such specifications are regarded as regular course loads.

Maximum Credit Loads

Students may enroll for course loads in excess of 15 credits but are advised that course loads in excess of the number of credits specified by recommended courses of study may not be in their academic interests when their grade-point averages are less than 3.00.

Unless specified as part of an established course of study, course loads in excess of 15 credits are recommended for enrichment purposes only and should be taken as pass courses. In any event, a student is prohibited from registering for course loads in excess of 20 credits unless such loads are required by established University curricula or unless special per-

mission has been granted by the dean of the college in which the student has established matriculation.

Students who are enrolled in curricula which do not require a semester course load in excess of 20 credits and who wish to obtain permission to carry such an overload must file an academic petition with the dean of the college in which they have established matriculation. Students who register for course loads in excess of 20 credits (including continuing education courses) without the prior authorization of the dean of the college in which they have established matriculation will not receive credit for more than 20 credits per semester and the college dean shall determine which course(s) shall receive the administrative symbol of Y. Permission to carry course loads in excess of stated maxima will be denied when resources of a college or program render it necessary to establish limitations on course enrollments.

Minimum Credit Loads

Matriculating students are classified as full-time when they carry a course credit load in University day programs which is specified by their curricula. Full-time students are required to register for a minimum of 12 credits of day courses each semester, and unless subsequently granted reduced load status, to remain registered for 12 credits of day courses at all times.

Part-time Enrollment

A matriculating student who desires to enroll on a part-time basis, i.e., to register for fewer than 12 credits in a given semester, must complete an Application for Part-time Enrollment (available in the Office of Academic Affairs) and submit the application to the Office of Academic Affairs prior to the last day for adding courses in that semester. Permission, if granted, is applicable only for that specific semester and is not automatically renewed.

Students enrolled in the Encore Program and cooperative education students are permitted to register for fewer than 12 credits without prior permission.

A student who is approved for enrollment on a part-time basis is charged by the credit hour for tuition and all applicable fees.

Students who apply for permission to enroll on a part-time basis should understand that part-time enrollment may have an impact on financial aid and on eligibility for insurance through non-University agencies. Students who enroll for fewer than six credits may be required to begin repayment of student loans. Varsity athletes and international students on I-20 permits must enroll in a minimum of 12 credits per semester and may not be part-time students.

Repeated Coursework/Course Deletions**General Policies**

Course repetition is permitted only in accordance with the policies cited below, the provisions of which are applicable only to courses taken at the University of Massachusetts Lowell and consequently do not apply to off-campus courses. A course substitution is not permitted under the provisions of this regulation unless a course has been dropped as a University offering and an alternate course has been authorized as a suitable substitution by the chairperson of the department which offered the course. Once a student has reached the credit limitations which are cited below, no further courses may be replaced for the purpose of grade substitution, nor may a student who has used the maximum number of course repetitions for the purpose of grade substitution petition to revoke one or more of these substitutions in order to permit course repetition and grade substitution in an additional course or courses.

Grade Substitution/Deletion Rule

Students who have entered the University as freshmen or transferred to the University with less than 60 semester credits are permitted a maximum of fifteen semester credits of course repetitions/deletions for the purpose of removing grades of CD or less for previously completed courses in the computation of their cumulative grade-point averages. (Transfer students who have entered the University

ACADEMIC POLICIES

with 60 or more credits are permitted a maximum of seven semester credits of course repetitions for this purpose.) The number of actual course repetitions which are permitted for any student depends upon the number of credits which are allocated to those courses which he or she wishes to repeat.

Administrative Requirements

When students register for courses which they wish to repeat, they must notify the Office of Enrollment Services at the time of registration for the fall or spring semester, or at the time of registration for University summer sessions.

Repetition of Passed Courses

Except for courses of a professional nature which regulations of a college may designate as being non-repeatable, students may repeat a course previously passed with a grade of CD or D within the provisions of the grade substitution rule cited above. When a previously passed course has been repeated within the provisions of this regulation, the cumulative grade-point average is appropriately corrected for the semester in which the course is repeated. If the grade for the repeated course is lower than the original grade in the course, the lower grade may be deleted under the provisions of the grade deletion rule (see above). Credit is never granted twice for a course which has been taken and passed and subsequently taken again and passed for the second time.

Repetition of Failed Courses

Except for courses of a professional nature which regulations of a college may designate as non-repeatable, students may substitute passing grades for repeated failed courses in the computation of cumulative grade-point averages. Except for non-repeatable courses, students must repeat all required courses which they have failed. Courses in which F grades have been received must be repeated and passed before students may take courses for which those failed are prerequisites. A course which is failed but is not required for a student's program need not be repeated, but other course work must be

taken when a student's total degree program will fall short of the specified credit hours for degree requirements. Unless a failed course is repeated within the deadlines for grade substitution, cited above, both the original failing grade and the repeated course grade are counted in computing grade-point averages. Although the provisions of the grade substitution rule and the requirements for maintaining satisfactory academic standing may indirectly limit the number of failed courses which a student may repeat, no formal limitation is placed upon the number of failed courses which may be repeated.

Repetition of Transferred Courses

When competence is demonstrably inadequate, a student who has been granted transfer credit (and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite) may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred.

Permission to repeat a transferred course is granted by filing an academic petition form with the dean of the college. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

University of Massachusetts Lowell Division of Continuing Education and Summer School Courses

Subject to University residency requirements and college regulations,* the following categories of day students may be permitted to register for continuing education and summer school courses at the University of Massachusetts Lowell and to have such courses credited to baccalaureate day programs:

1. individuals who have been admitted to day colleges for full-time baccalaureate study;

2. individuals in satisfactory academic standing who are currently matriculating in day colleges of the University;** and
3. previously matriculated students in day colleges who withdrew from the University while in satisfactory academic standing, who have been absent from the University for periods of not more than two semesters, and who have been readmitted to programs in which they were previously enrolled.

Individuals are warned that departments reserve the right to deny baccalaureate credit for University of Massachusetts Lowell continuing education and summer school courses which have been taken in violation of University residency requirements, curriculum requirements of their baccalaureate day programs, and/or special college regulations. Accordingly, individuals are advised to consult appropriate sections of this publication prior to enrolling in continuing education and summer school courses of the University in order to avoid subsequent denial of course credit during the period when programs of study are reviewed for the purpose of determining student satisfaction of degree requirements. Students who have been suspended or dismissed from day programs of the University are prohibited from enrolling in any program of the University. Students who combine University day courses with continuing education courses during the regular academic year are subject to all restrictions concerning semester course loads (cf. "Registration and Course Enrollment Policies").

*Special authorization is required by the College of Management for continuing education courses in areas of accounting, economics, and management.

**Students on academic warning are permitted to register for continuing education and summer school courses; students who have been suspended are prohibited from enrolling in any course offered by the University.

*Course Requirements***Off-Campus Study**

Matriculating students in satisfactory academic standing may be permitted to apply off-campus courses to their degree programs when they comply with established procedures. Students wishing to apply credits earned off-campus must obtain approval prior to off-campus enrollment, through an "Authorization of Off-Campus Courses" form available in the Office of the Enrollment Services. Off-campus courses may be taken in regionally-accredited institutions only, and ordinarily should be taken at baccalaureate colleges or universities.

Permission to pursue off-campus courses in regionally-accredited associate degree institutions may be granted to students with less than 61 earned credits and only for courses which are to be presented for lower-division requirements of University of Massachusetts Lowell curricula. All off-campus courses must be taken under the regular grading system and may not be taken on a pass-no credit (pass/fail) basis.

University Restrictions Concerning Off-Campus Study

Students are not permitted to pursue off-campus courses until an initial evaluation of their academic progress at the University has been made. Students who have transferred to the University with 60 or more semester credits, or who have been admitted from another institution with a baccalaureate degree to pursue a second bachelor's degree, are not permitted to pursue off-campus studies. Students who combine University courses with off-campus courses during the regular academic year are subject to University restrictions on semester course loads.

Off-Campus Study Year Abroad and Visiting Student Programs

Off-campus courses may be authorized for those students who have completed (or who will complete prior to graduation) 90 semester credits at UMass Lowell and who wish to pursue studies abroad or who wish to study as visiting students at another baccalaureate institution while completing a Lowell degree.

Prior to departure, students planning to undertake off-campus study should present to the dean of the college of their enrollment an academic petition which seeks authorization of the proposed course of study. Following a review of the petition and of the proposed course of study, the dean will endorse the petition, informing both the student and the Director of Enrollment Services of the acceptability of the course of study to the student's degree program.

Since some colleges of the University do not permit off-campus study, students should ascertain the policy of their college before pursuing arrangements with other institutions. Students who wish to pursue off-campus studies are advised that they must satisfy academic and residency requirements concerning courses in the major field (cf. "General Degree Requirements: Residency Requirements").

Calendar Deadline Changes of Course Enrollment Status

The last day for students to add a course, to change sections within a course, and to change enrollment status from audit to credit or from credit to audit and from pass-no credit to letter grade or from letter grade to pass-no credit is the tenth class day of the semester. The last day for dropping a course without penalty (with a course notation of W) is the 50th class day of the semester. Students must file all change of status forms in the Office of Enrollment Services by the published calendar deadlines.

Advisory System

Academic advising is performed by full-time faculty members. Students who have been accepted by departments for academic or professional majors receive their academic advising from a member of their major department or, in the case of students pursuing interdisciplinary majors, from members of an appropriate interdisciplinary committee. Students who have not made declarations of their major fields are assigned faculty advisors from within the college in which they are enrolled. Entering students are advised during the period of initial registration by a cadre of

faculty advisors and are subsequently assigned advisors on the basis of their declarations of major subject. If an advisor has not been assigned by the beginning of the advisory period of the student's second registration, the student should immediately reveal this fact to the dean of the college in which he or she is enrolled.

The faculty advisor assists the student in developing a program of courses prior to semester registration and in formulating a program of studies leading to a degree and generally provides whatever guidance and assistance a student may require in making appropriate academic decisions throughout his or her period of baccalaureate studies. However, each student is personally responsible for complying with all rules and regulations of the University and is solely responsible for completing all degree requirements.

The advisor maintains records showing the program of study for each of his or her assigned students, including subjects taken, grades earned, and changes of contemplated programs. For the purpose of providing appropriate academic advising, each faculty member is available for consultation throughout the semester. Faculty members maintain three office hours per week on three different days during periods in which classes are scheduled and maintain a minimum of five office hours per week during periods of student advisement for course registration. Schedules of office hours are published by departments for their members and the schedule of faculty office hours for each faculty member is posted in such a manner as may be observed easily by students.

Course Requirements

Within the policies listed below, faculty members are permitted to establish their examination and course requirements.

Course Examination Policies

Final examinations are required for all undergraduate courses of the University unless exemptions have been granted by the department chairperson and the dean of the college. Exemption requests must be made by the end of the first month of the semester. Final examinations may not be

given at a place or time other than those which have been specified by the Director of Enrollment Services. There shall be no final examinations other than those administered during the final examination period. No hour examination shall be administered during the last five academic days of the semester unless exemption has been allowed by the college dean. Final take-home examinations may be submitted to instructors during the final examination period only. Take home examinations may be submitted only on the day and at the time which the Director of Enrollment Services has scheduled the final examination for the course in question.

Instructor Course Requirements

By the end of the first full week of classes, instructors must distribute a written statement of requirements, prerequisites and corequisites for each course and section to all students and to the department chairperson. This statement must include a specification of the number and types of course evaluations to be employed throughout the semester (including approximate date and nature of the first evaluation), special requirements for completing assignments and taking examinations, and a definition of course attendance policy. By the end of the seventh week of classes, each faculty member and course coordinator must provide the department chairperson with the date, time, and nature of the first evaluation in the course.

Normally, a minimum of three evaluations of student progress (written or oral examinations, written reports, recitations, laboratory techniques and reports, jury or performance evaluations) should be made in each course, at least one evaluation being required during each half semester. Upon the request of a student, an instructor is required to provide a statement of the student's course progress. Prior to the last date for withdrawing from courses, students who are in danger of receiving D or F grades either shall be so notified by the instructor or shall be in possession of such course evaluations as will permit such students to reasonably infer their course progress and academic jeopardy.

Student Complaints

Complaints Arising from Grades and Grading Policy of the Faculty Member

Faculty are expected, as a matter of right and professional standards, to recompute any grade in which a computational error is alleged or suspected, provided that the student challenges the grade before the deadline established by the calendar for filing final course grades and grade changes. However, no challenge or appeal shall be allowed in the matter of grades and grading policies except when a faculty member is alleged to have violated University, college, or department academic regulations and policies, or the faculty member's own grading policy; the latter to be determined from the published course requirements for the course or section in question.

Appeals of grades or grading policies arising from alleged violations of established or published policies will follow procedures cited below under the heading "Complaints Concerning Classroom Matters." The terms "grade" and "grading policy" refer 1) to all grades awarded, 2) to the computation of grades for examinations (including final examinations), tests, quizzes, papers, essays, laboratory reports, practicum experiences, and any other kind of academic activity for which a grade of any kind is awarded, and 3) the final course grade which is submitted to the Office of Enrollment Services.

Complaints Concerning Classroom Matters Exclusive of Grades and Grading Policy

Students confronting classroom problems which are a source of legitimate concern are entitled to have their complaints heard and resolved according to the procedures specified below.

Classroom problems may include, but are not limited to, the following examples (but note that questions concerning grades and grading policies are reserved to the process specified above):

1. faculty failure to observe University policy and/or regulations, such as violating the regulation against scheduling examinations during the last week of the semester;

2. changing class schedules without the permission of the department chairperson and the college dean, or rescheduling of final examinations (including setting a due date for take-home examinations) to a time and place other than that established by the Office of Enrollment Services;
3. terminating semester classes prior to the date specified by the University calendar;
4. failing to fulfill instructional obligations (such as unjustified cancellation of classes, frequent absenteeism, and lateness);
5. failing to provide and distribute a written statement of course requirements which is mandated for all instructors;
6. failing to adhere to the written statement of course requirements; and
7. failing to post office hours or to maintain such hours.

Students normally should seek to resolve problems by discussion with the faculty member. If this is not feasible (e.g., for reasons of intimidation or threat) or if, after discussion, the matter cannot be resolved, the student shall inform the faculty member in writing that he or she will initiate a formal complaint. This complaint shall be in writing and shall be addressed jointly to the chairperson of the department and the dean of the college in which the alleged problem and/or violation occurred. After discussing the problem with the student and the faculty member, the chairperson and the dean will make a determination. Should the subject of a formal complaint be a department chairperson, the review and determination will be made by the dean and the chairperson of another department. Copies of the complaint, together with the written decision of the chairperson and the dean, shall be sent to the student, the faculty member, the Provost and Vice Chancellor for Academic Affairs, and the President of the MSP.

Formal complaints about classroom problems shall be initiated before the last day of the semester examinations in the semester during which the violation is alleged to have occurred. The determination of the chairperson and the dean shall be made within ten working days following receipt

Course Descriptions

of the student complaint and, if unchallenged by the MSP, shall be final.

Discrimination and/or Harassment

Any student who believes that he or she has been discriminated against on the basis of sex, race, color, national origin, creed, religion, age, handicap, or veteran's status or that the University in any of its aspects is operating in a manner which adversely affects female, minority or handicapped students or veterans should contact the Affirmative Action Officer/Coordinator for Title IX and Handicapped Affairs immediately. Alleged discrimination or harassment which does not come under the purview of the Affirmative Action Office should be pursued in accordance with the procedures outlined above for the resolution of classroom problems.

Attendance Policies

Although the University does not require class attendance as a matter of institutional policy, course instructors have the option of establishing required attendance in their courses and of specifying penalties for student violations of such attendance requirements. Colleges also have this option and sometimes have adopted attendance policies for introductory courses and specialized learning situations.

Instructor Attendance Policies

At the beginning of each course, the instructor will inform students of any specific attendance regulations which apply.

Attendance Requirements of the Veterans Administration

In compliance with the requirements of the Veterans Administration (VA), all recipients of Veterans benefits, including eligible children of veterans, must certify their attendance at the University under penalty of perjury by the following procedures:

On the first Monday of each month, or on the following day if Monday is a holiday, each recipient of VA benefits is required to register his or her attendance at the office

of the dean of his or her college. This procedure is also repeated on the third Monday, or on the following day if Monday is a holiday. All changes in status of the VA recipient also must be reported.

Failure to register attendance will be reported immediately by the college dean to the Registrar, who will attempt to contact the student personally. If no satisfactory response is elicited for failure to register within one week of the reporting date, or if the Director of Enrollment Services is unable to reach the student at his or her official residence, the Director of Enrollment Services will inform the Veterans Administration that the University is unable to verify this student's attendance.

Absence of Students for Religious Beliefs

Chapter 375, Acts of 1975 of the Commonwealth of Massachusetts requires recognition of student religious beliefs as noted.

"Any student who is unable, because of his religious beliefs, to attend classes or to participate in any examination, study, or work requirement on a particular day shall be excused from any such examination or study or work requirements, and shall be provided with an opportunity to make up such examination, study, or work requirement which he may have missed because of such absence on a particular day; provided, however, that such make up examination or work shall not create an unreasonable burden upon such school. No fees of any kind shall be charged by the institution for making available to the said student such opportunity. No adverse or prejudicial effects shall result to any student because of his availing himself of the provisions of this section."

Students should inform the course Instructor in writing of the day(s) they will be absent. This should be done as early as possible in the semester and always prior to the day(s) the student will be absent for religious reasons.

Right of Access to Student Records

The Family Rights and Privacy Act of 1974 grants any student currently in attendance, or to any former student, the right of access to inspect or review his or her educational files, records, or data. Students who wish to inspect their records must file a Right of Access form with the office or department in which the desired record is kept. Right of Access forms are available in the Office of Student Services. Within ten days of receipt of the Right of Access form, the office or department will notify the student as to the date, time, and location when the desired record will be available for inspection.

The University maintains the following general records on students:

- Admission File
- Admissions Office
- Dugan Hall, South Campus
- Permanent Academic Records
- Office of Enrollment Services
- Southwick Hall, North Campus
- Financial Aid Records
- Financial Aid Office
- McGauvran Student Union Building
- South Campus
- Health Records
- Health Services Building
- North Campus
- Temporary Academic Records
- Office of the Dean, Department Chairperson, or Faculty Advisor
- Account and Payment Records
- Business Office
- Dugan Hall, South Campus

The file of each student must contain a record of all non-University affiliated individuals or organizations requesting access to it, plus statements which specify the legitimate educational purposes for which access was requested. The record of access may be released only to University personnel or to state or federal officials as a means of auditing the reporting of access

ACADEMIC POLICIES*Honorary and Professional Societies*

to student records.

Information or records concerning individual students may not be released to any individual or agency without written permission of the student. Any request for such information received without such written notice will not be honored and will be returned with a request for a written release by the student.

Educational records may be released without permission to the following individuals or agencies under the following specific conditions:

1. personnel of the University, i.e., faculty, administrators, or staff for legitimate educational purposes only;
2. officials of other institutions in which the student is enrolled, provided that the student is notified of the release;
3. federal or state officials in connection with the audit and evaluation of programs funded by the federal or state governments or in connection with the enforcement of legal requirements which relate to such programs or in connection with the student's application for or receipt of financial aid;
4. state and local officials pursuant to any state statute adopted prior to November 19, 1974;
5. organizations conducting studies for the purpose of developing predictive tests, administering student aid programs, and improving instruction;
6. accrediting organizations in order to carry out their accrediting functions;
7. parents who claim the student as a dependent on their IRS statement; and
8. when necessary in an emergency, to protect the health, safety or welfare of the student or others, to persons who are in a position to deal with the emergency.

The following data is considered informational in nature and may be released, without permission of the student, at the discretion of the University: name, city/town of residence, University mail box #, date of birth, previous educational institution(s) attended, major field of study, dates of attendance, awards & honors received, degrees conferred, past and present participation in officially recognized

sports & activities and height & weight of athletic team members. Any student who believes that his or her records are inaccurate or misleading may request a hearing with the Associate Provost to discuss the contents of such records. Additional information on procedures or policies relating to University compliance with the Family Rights and Privacy Act can be obtained from the Office of Student Services.

Course Descriptions

Each course offering is designated by a two-digit prefix and a three-digit course number. The two digit college prefix identifies a college department and/or special area. The three-digit course number identifies the course level.

Course Prefixes

Each college department and/or special subject area has been assigned an identifying two digit number (e.g., 92.131) within the numerical ranges specified as follows:

Education	01-09
Engineering	10-28
Health Profession	30-39
Liberal Arts	40-59
Management	60-69
Fine Arts	70-79
Science and Math	80-99

Course Numbers

A course number consists of three digits which follow the course/department prefix (for example, 92.131). Courses numbered 001-099 are pre-freshman and special undergraduate courses and do not carry baccalaureate degree credit. Those numbers 100-299 are lower division undergraduate courses and those numbered 300-499 are upper division undergraduate courses. The 400 level courses are generally limited to juniors and seniors majoring in a field but are open, with permission, to other advanced undergraduates and to graduate students. Directed studies courses and practicum experience courses are generally limited by departmental policy to students majoring in the

area in which such courses are offered. Courses numbered 500-599 are graduate courses which are open to upper division undergraduates with the consent of instructors and chairpersons. Courses numbered 600-699 are graduate courses which are open only to graduate students. Courses numbered 700-799 designate graduate research projects and graduate theses.

Semester, Class, and Credit Designations

Courses which are offered during the fall semester are designated by the Roman numeral I; spring semester courses are designated by the Roman numeral II; and courses which are offered during both fall and spring semesters are designated by the Roman numerals I, II. Courses which are not prescheduled for specific semesters carry no Roman numerical designation. In the event that a course is offered during the first half of a semester, the Roman numeral is followed by the letter A. A course which is offered during the second half of a semester is followed by the letter B.

Arabic numbers enclosed in parentheses indicate the number of hours of lecture/recitation and of laboratory/applied activity. The Arabic number following the numbers in parentheses is a designation of course credit. For example the designation IB(6,0)3 means that a course is offered during the second half of the fall semester, requires six hours of lecture/recitation per week and carries three semester credits. Similarly, the designation II(2,6)4 means that a course is offered during the spring semester, requires two hours of lecture/recitation per week and six hours of laboratory/applied activity per week and carries four semester credits.

Course Restrictions

Special course prerequisites, corequisites, and enrollment restrictions are indicated at the end of the course description. A course which is listed as a prerequisite must have been completed and passed prior to taking the course for which the prerequisite is specified. Subject to college or department policy to the contrary, an

Faculty

exception to this limitation may be granted by the designated instructor only. A course which is listed as a corequisite must be taken during the same semester as the course for which the corequisite is specified. Courses which carry such notations as "open for majors only" and "sophomore status required" are restricted to the specified students. Courses which carry the notation "permission of instructor" require instructor approval in order to enroll. Courses at the 100-300 levels which do not carry prerequisite, corequisite, and enrollment restrictions are open for election by all students unless general restrictions have been listed under the department or course area heading, or unless policy of the college or department in which the student is matriculated prohibits such registration.

Society for Physics Students
Society for Plastics Engineers
Society for the Advancement of Management
Tau Beta Pi (Engineering Honor Society)

Honorary and Professional Societies

Alpha Nu Sigma (Nuclear Science and Engineering)

American Chemical Society

American Society for Chemical Engineers

American Society for Civil Engineers

American Society for Mechanical Engineers

American Meteorological Society

American Nuclear Society

Association of Pulp and Paper Industry

Eta Kappa Nu (Electrical Engineering)

Institute of Electrical and Electronics Engineers

Music Educators National Conference

Pi Lambda Theta (Education)

Pi Mu Epsilon (Mathematics)

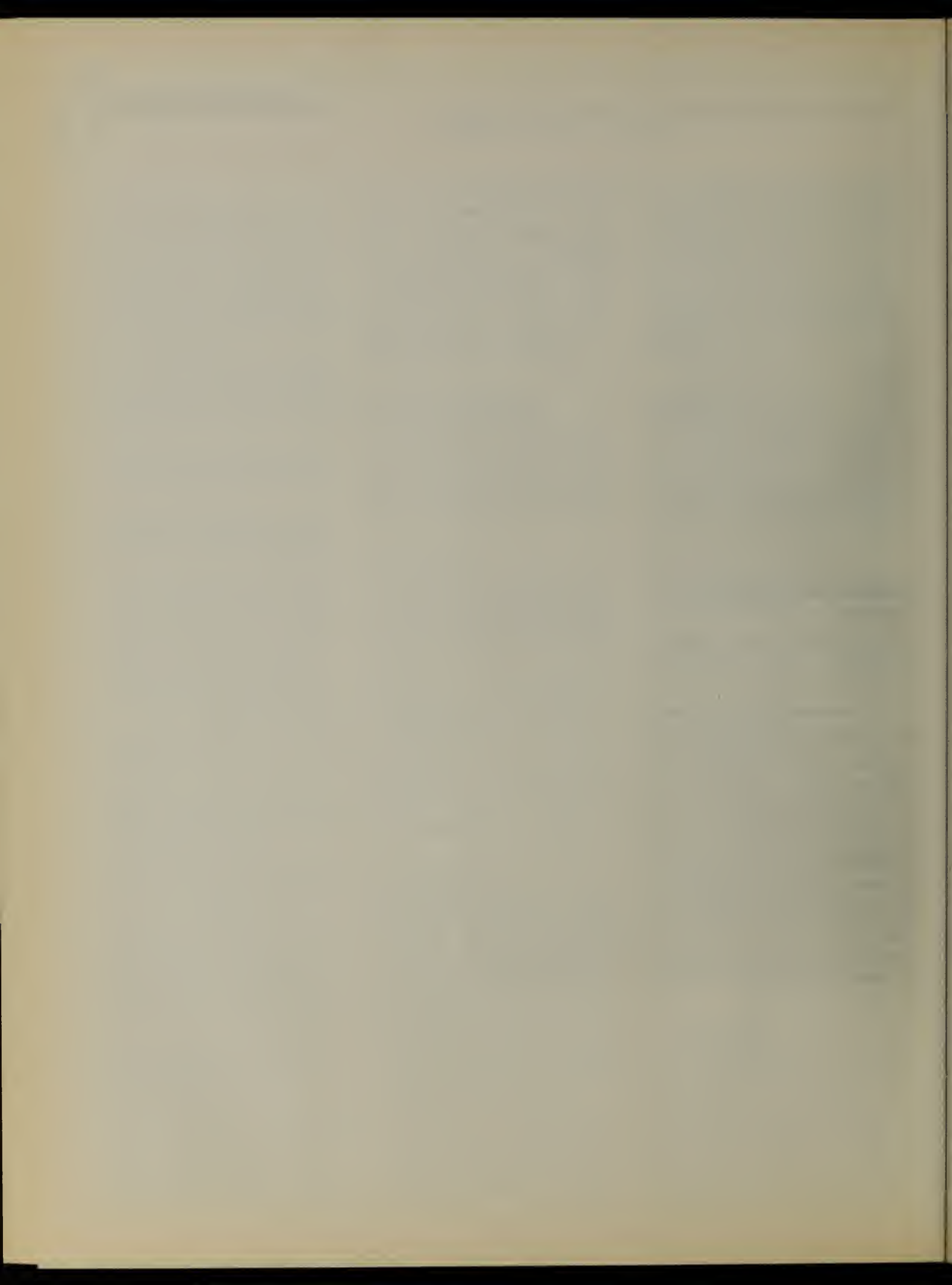
Pi Tau Sigma (Mechanical Engineering)

Radiological Health Physics Society

Sigma Gamma Epsilon (Earth Sciences Honor Society)

Sigma Theta Tau, Eta Omega Chapter (Nursing)

Sigma Xi



Aerospace Studies



The program is designed to qualify for commissions those men and women who desire to serve in the United States Air Force and to provide an education which will develop skills and attitudes of vital importance to professional Air Force officers. The Air Force ROTC program is divided into two phases:

- 1) the General Military Course (GMC), and
- 2) the Professional Officer Course (POC).

Students may elect to enroll in either the four-year or the two-year AFROTC program. Students electing the four-year program will take the General Military Course during their freshman and sophomore years which consists of one hour of class and two hours of leadership laboratory per week. Students in the four-year program attend four weeks of field training during the summer between their sophomore and junior years. As members of the program, they are eligible to compete for AFROTC scholarships. For acceptance into the Professional Officer Course, students enrolled in the four-year program must meet physical standards, pass an officer qualification test, possess an acceptable academic record, and meet Air Force commissioning criteria. The POC consists of three hours of class and two hours of leadership laboratory per week.

To qualify for enrollment in the two-year program, students must have two academic years remaining at either the graduate or undergraduate level or combination of these levels. They must meet physical standards, pass an officer qualification test, possess an acceptable academic record, and meet Air Force commissioning criteria. They must also successfully complete a six-week field training course before they can be accepted into the POC.

Lt. Col. Elizabeth A. Lambert, Chairperson

Aerospace Studies

Lt. Col. Elizabeth A. Lambert, Chairperson

Professor: Elizabeth A. Lambert

Assistant Professors: David A Pavilaitis,
Paul Ostrowski

University Policies Concerning Aerospace Courses

Both General Military Courses (AS 100 and AS 200) and Professional Officer Courses (AS 300 and AS 400) in Aerospace Studies may be used as undesignated or unrestricted elective courses in a student's baccalaureate program. Grades for all AFROTC courses are applicable to the determination of grade-point averages. Students should consult the regulations of the college in which they are matriculating concerning the number of AFROTC courses which may be included as part of their programs of study. In the event that such elective courses are insufficient to accommodate all the AFROTC courses, students wishing to pursue the AFROTC program will be required to fulfill program requirements on an overload basis. Consequently, AFROTC credit toward graduation requirements will vary from six (minimum to meet AFROTC/University of Massachusetts Lowell contract requirements) to sixteen credits dependent on the student's particular college and degree program. Some colleges allow AFROTC courses to be substituted for technical or general electives.

AFROTC Requirements

Uniforms, equipment, and textbooks which are required for AFROTC will be supplied. Students in the POC or on scholarship receive a monthly subsistence allowance of \$150.00. Competitive scholarships are available for academically qualified cadets in the program. Students who successfully complete the POC are commissioned as second lieutenants in the United States Air Force and serve on active duty in the Air Force.

All GMC scholarship cadets must satisfactorily complete a course in English composition within two years of the scholarship activation. In addition, all scholarship cadets must satisfactorily complete a course in mathematical reasoning prior to commissioning.

Field training

AFROTC field training is offered during the summer months at selected Air Force bases throughout the United States.

Students in the four-year program participate in four weeks of field training, usually between their sophomore and junior years. Students applying for entry into the two-year program must successfully complete six weeks for field training prior to enrollment in the Professional Officer Courses.

The major areas of study in the four-week field training program include junior officer training, aircraft and aircrew orientation, career orientation, survival training, base functions and Air Force environment, and physical training.

The major areas of study included in the six-week field training program are essentially the same as those conducted at four-week field training and in the General Military Course including leadership laboratory.

Leadership Laboratory

Leadership Laboratory is taken an average of two hours per week throughout the student's period of enrollment in AFROTC. Instruction is conducted within the framework of an organized cadet corps with a progression of experiences designed to develop each student's leadership potential. Leadership laboratory involves a study of Air Force customs and courtesies; drill and ceremonies; career opportunities in the Air Force; and the life and work of an Air Force junior officer. Students develop their leadership potential in a practical, supervised laboratory, which typically includes field trips to Air Force installations throughout the United States.

The Department of Aerospace Studies is a unit of the Office of Academic Affairs and conducts the Air Force ROTC program. All ROTC courses, with the exception of leadership laboratory may be taken by any university student for credit without actually joining the AFROTC program. Call (508) 934-2252 or stop by Southwick 328, for additional information.

Aerospace Studies (Course Prefix: 29)

29.101 The Air Force Today - Part I

Topics relating to the Air Force and defense. Structure and missions of Air Force organizations; officership and professionalism; and includes an introduction to communicative skills. 1 cr.

29.102 The Air Force Today - Part II

Completion of the Material described in 29.101. 1 cr.

29.201 The Development of Air Power - Part I

Factors contributing to the development of air power from its earliest beginnings through two World Wars; the evolution of air power concepts and doctrine; and an assessment of communicative skills (speaking and writing). 1 cr.

29.202 The Development of Air Power - Part II

Completion of the Material described in 29.201. 1 cr.

29.301 Air Force Management and Leadership - Part I

Emphasizing the individual as a leader/manager in a Fortune 500/Air Force setting. The individual motivational and behavioral processes, leadership, communication, and group dynamics are covered to provide a foundation for the development of the professional skills needed by Air Force officers and middle managers. The basic managerial processes involving decision-making, utilization of analytic aids in planning, organizing, and controlling in a changing environment are emphasized as necessary professional concepts. Organizational and personal values, management of forces in change, organizational power, politics, and managerial strategy and tactics are discussed within the context of the military organization. Actual Air Force and corporate case studies are used to enhance the learning and communication processes. 3 cr.

29.302 Air Force Management and Leadership - Part II

Continuation of the material described in 29.301. 3 cr.

29.401 National Security Forces in Contemporary American Society-Part I

An examination of the needs for national

College Policies and Requirements

security; an analysis of the evolution and formulation of the American defense policy and strategy; aerospace doctrine; an examination of the methods for managing conflict; and an overview of alliances and regional security, arms control, and terrorism. Special topics of interest focus on the military as a profession, officership, the military justice system, and current issues affecting military professionals. Continued emphasis is given to the refinement of communicative skills. 3 cr.

**29.402 National Security Forces in
Contemporary American Society
-Part II**

Continuation of the material described in 29.401. 3 cr.

Faculty of Aerospace Studies

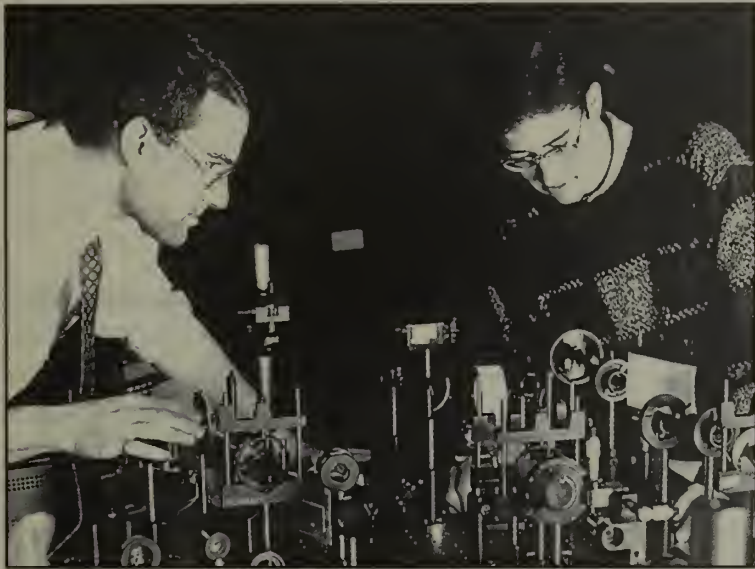
Elizabeth A. Lambert, Lieutenant Colonel, USAF, Professor of Aerospace Studies; B.A., University of Colorado; M.B.A., Western New England College.

Paul Ostrowski, Captain, USAF, Assistant Professor of Aerospace Studies; B.A., University of Colorado; M.B.A., Western New England College.

David A. Pavilaitis, Captain, USAF, Assistant Professor of Aerospace Studies; B.S., Southern Illinois University; M.B.A., Embry-Riddle Aeronautical University.



College of Arts and Sciences



The College of Arts and Sciences occupies a central position at the University, providing students with the individual and collective achievements of humanity and the nature of the physical world. Faculty in Arts and Sciences encourage interdisciplinary study and integrative thinking. Studies in the College of Arts and Sciences can serve as the springboard for a degree in an Arts and Science major or another of the University's Colleges.

The College of Arts and Sciences offers the Bachelor of Arts and the Bachelor of Science degrees in eighteen major fields, with a number of options and minors. The undergraduate degree offers students a sound, broad foundation of general education with preparation in a specific area for entrance into a professional field or continued study at the graduate level. The College also offers several Master's and Doctoral degree programs in conjunction with the Graduate School. The mission of the College is tripartite - with equal and intertwined emphasis placed on teaching, research, and public service to a diverse community. Commitment to this mission influences the College's teaching methods, curricular offerings, and extracurricular opportunities.

The greatest benefit of a college education is not the specific materials learned in a course of study but rather the ability to think, to analyze, and to adapt to changing times. Most working people will change careers at least once, and many of the careers that exist today that require a college education did not exist when their practitioners were in college. Thus, to be successful in the job market and to develop a satisfying and rewarding career, a student must develop a broad base of knowledge, learn to think critically, and adapt to a changing economy. Students seeking that breadth and diversity are well-served by the curriculum offered through the university of Massachusetts Lowell's College of Arts and Sciences.

Nancy Kleniewski, Dean of Humanities and Social Sciences

Robert H. Tamarin, Dean of Sciences

COLLEGE OF ARTS AND SCIENCES

College Policies and Requirements

Mission of the College

The College of Arts and Sciences is committed to the promotion of scholarly research and creative achievement. We seek to foster the development of knowledge and inquiry to support both the instructional and public service goals of the institution. We emphasize quality instruction in all academic programs and are committed to active involvement in community service.

In line with these goals, the College of Arts and Sciences seeks to examine the fundamental concepts of that overall mission: to engage in and foster critical and creative thinking for future solutions to environmental, economic, and human problems, the capacity to respond to changing times to help students develop. The College serves the economic and social needs of the Merrimack Valley region. Students and faculty apply their scholarly knowledge in community settings through community based research and internship programs.

The College combines the teaching of professional skills with the development of critical inquiry and thinking, including a response to varying value systems, in an effort to provide students with the talents they will need to meet future economic and social challenges and to shape the future with both creativity and assurance.

College Facilities

Departmental Facilities

The faculty offices, including those of department chairpersons are housed in the following locations:

On the North Campus:

Biological Sciences	Olsen Hall
Chemistry	Olney Hall
Computer Science	Olsen Hall
Environmental, Earth, and Atmospheric Sciences	Olney Hall
Economics	Falmouth Hall
Mathematics	Olsen Hall
Philosophy	Olney Hall
Physics	Olney Hall

On the South Campus:

Criminal Justice	Mahoney Hall
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English	O'Leary Library
History	Coburn Hall
Languages	Coburn Hall
Political Science	Coburn Hall
Psychology	Mahoney Hall
Regional Economic & Social Development	O'Leary Library
Sociology	Coburn Hall

The Deans' Office is located on the fifth floor of Olney Hall, North Campus.

Special Facilities

Special facilities of the College include experimental laboratories for animal and human learning, microcomputer laboratories, a criminalistics laboratory, and a language laboratory. Among other facilities, the College also houses teaching laboratories, modern computer equipment, undergraduate and graduate research facilities, office research modules, service areas such as animal quarters, rooms for instrumentation, preparation, temperature and humidity control; x-ray equipment, electron microscopes, a greenhouse, a nuclear reactor, and a linear accelerator.

Center for Women in Engineering and Science

The Center for Women in Engineering and Science provides a supportive and inclusive environment for women pursuing careers in engineering and science. It offers information about pathways to resources and services available on campus as well as in government and the private sector. The Center also provides opportunities to contact industry and to help prepare women for entry into academic and industrial careers. The Center creates an environment for women students to support each other and to network among themselves.

Honorary and Professional Societies

Academy of Criminal Justice Sciences
Alpha Kappa Delta (Sociology)
Association for Computing Machinery (Computer Science)
American Chemical Society

American Meteorological Society
Gamma Kappa Alpha (National Italian Honor Society)
Optical Society of America (Physics)
Pi Mu Epsilon (Mathematics)
Psy Chi (Psychology)
Radiological Health Physics Society
Sigma Delta Phi (National Spanish Honor Society)
Sigma Gamma Epsilon (Earth Sciences Honor Society)
Sigma Xi

General Degree Requirements

To qualify for University degrees, baccalaureate candidates are required to obtain a 2.000 (C) average in their total course of study; to complete a minimum of 120 semester credits; to fulfill the minimum residency requirement designated for University day courses and for each major; to satisfy the regulations and academic standards of the colleges which exercise jurisdiction over the degrees for which they are matriculating; to complete all curriculum requirements specified by the college in which they are enrolled and department(s) in which they are majoring; and to complete the University general education requirements.

Programs of Arts and Sciences

American Studies
Biological Sciences
Biotechnology option
Chemistry
Computer Science
Criminal Justice
Economics
English
Environmental Science
Atmospheric Science concentration
Environmental Studies concentration
Geoscience concentration
History
Mathematics
Applied Mathematics option
Scientific Computing option
Statistics & Operations Research option

*College Policies and Requirements***Modern Languages**

French option
Spanish option

Philosophy

Communication and Critical
Thinking option

Physics

Optics option
Applied Physics option
Radiological Health Physics option

Political Science

Psychology
Sociology

Baccalaureate Degree Program for Students in the Social Sciences and Humanities

The social sciences and humanities departments in the College of Arts and Sciences offer undergraduate programs leading to the degree of Bachelor of Arts, Bachelor of Science, and Bachelor of Liberal Arts. The B.A. and B.L.A. degree programs provide a broad, comprehensive education with many options for developing major and minor programs and provide preparation for graduate programs requiring a general liberal arts background. The only Bachelor of Science degree available to students in the social sciences and humanities is in the Major of Criminal Justice. The Bachelor of Liberal Arts degree is offered as an alternative to the Bachelor of Science or Bachelor of Arts degrees and allows the student to build a concentration of up to sixty hours in two linked disciplines.

Bachelor of Arts Degree

Curricula leading to the Bachelor of Arts degree provide a broad, comprehensive education with many options for developing major and minor programs. These options are specified by each of the colleges offering Bachelor of Arts degree programs and are sufficiently flexible to satisfy the individual needs of students while also providing sufficient preparation in the major field for subsequent specialization at the graduate level. All Bachelor of Arts degree programs require completion of a major within the college in which the student is a degree candidate and (except as specified by policies concerning second

majors) a minimum of 75 credits outside the major field. Following is a list of major fields in which the Bachelor of Arts degree is presently offered in the Humanities and Social Sciences.

American Studies
Economics
English
History
Modern Languages
Philosophy
Political Science
Psychology
Sociology

Bachelor of Science Degree

The Bachelor of Science degree provides students with specialized training. All Bachelor of Science degree programs require completion of a major within the college and a minimum of 50 credits outside the major field. The only major field for the B.S. degree currently offered in the Humanities and Social Sciences is Criminal Justice.

Bachelor of Liberal Arts Degree

The Bachelor of Liberal Arts is a baccalaureate degree program offered only to humanities and social science students in the College of Arts and Sciences. The essence of the BLA degree is that the student takes two disciplinary concentrations of 8 to 10 courses each. The degree offers students curricular flexibility and a broad background on the humanities and social sciences. Specific degree requirements are:

1. a total of 48 to 60 credit hours in the Humanities and Social Sciences, distributed as follows: Two concentrations of 8 to 10 courses (24-30 credit hours) each, with at least half at or above the 300 level;
2. under ordinary circumstance a minor will not be permitted;
3. students may choose to fulfill either a foreign language or a computer skills requirement; and
4. in the junior year Essay Writing for

Non-Majors.

The following concentrations have been approved for the Bachelor of Liberal Arts Degree:

Art History
Economics
English
History
Languages
Legal Studies
Philosophy
Political Science
Psychology
Sociology
Women's Studies

General College Requirements for Social Sciences and Humanities Students

In order to qualify for a baccalaureate degree offered by the College of Arts and Sciences, each undergraduate in the social sciences and humanities must comply with the University general education requirements, must conform to the rules of the College which govern degrees and major studies for such degrees, and must earn a 2.200 average in his or her major area(s) of concentration by the end of the senior year. Students who have failed to achieve a 2.000 average in their major concentration(s) by the end of the junior year (typically 27 hours in the major of 89 hours undertaken by the end of the junior year) have not made satisfactory progress toward their degrees, and upon the recommendation of appropriate departmental committees and the concurrence of the Dean of the College such students may be placed on probationary status within the college or dismissed from the University for inadequate scholarship.

COLLEGE OF ARTS AND SCIENCES

College Policies and Requirements

Minimum Degree Requirements

All degree programs include the following:

General Education Requirements 36-39 cr

Aesthetics - 1 course 3 cr

Behavioral and Social Sciences -
2 courses 6 cr

College Writing - 2 courses 6 cr

Historical Studies - 1 course 3 cr

Literature - 1 course 3 cr

Mathematics - 1 course 3 cr

Sciences & Technology -
3 courses 9-12 cr
(at least 2 courses with
experimental learning)

Values, Concepts and Choice -
1 course 3 cr

Bachelor of Arts

Liberal Arts Major 30-45 cr

Collateral & elective courses 37-54 cr
(including minor, if any)

Minimum degree requirements 120 cr

Bachelor of Liberal Arts

Concentration 48-60 cr

Collateral & elective
courses B.L.A. 21-36 cr

Minimum degree requirements 120 cr

Baccalaureate Degree Programs in Science and Mathematics

The science and mathematics departments of the College of Arts and Sciences offer undergraduate programs leading to the Bachelor of Arts degree and to the Bachelor of Science degree. Students who matriculate for the degree of Bachelor of Arts may pursue majors in Environmental Science. Students who matriculate for the degree of Bachelor of Science may pursue majors in biological sciences, chemistry, computer science, environmental science (geology or meteorology option), mathematics (applied mathematics, scientific computing, or statistics and operations research option), and physics (radiological health physics, optics, or applied

physics option). Students should consult the Graduate School catalogue for information concerning master's programs in biological sciences, chemistry, computer science, mathematics, physics and applied physics, polymer science, radiological sciences and protection, and doctoral programs in chemistry, computer science, physics and applied physics.

In addition to satisfying general University requirements for baccalaureate degrees as are defined elsewhere in this publication under the heading "Academic Policies: Baccalaureate Degrees," students who matriculate for degrees in the College of Arts and Sciences also must complete a specific minimum number of courses and credits in the College of Arts and Sciences. These college requirements are described below. Except as specified by the college and program restrictions, students are permitted to elect any course for which they can satisfy prerequisite requirements in fulfilling an unrestricted elective requirement. However, in order to designate courses from other colleges of the University as science or mathematics courses, students must petition the chairperson of the department in which they are enrolled as majors.

Minor areas of study which are offered by the various departments of sciences and mathematics are as follows: biological sciences, chemistry, geology, mathematics, physics and radiological health physics. College majors may also wish to consider minors offered by the social science and humanities departments, College of Fine Arts, and specialized course sequences of the College of Engineering. All minor programs of the University require 18-24 credits, six of which must be at the 300 course level or above.

The curriculum in Environmental Science leading to the Bachelor of Arts degree is designed to provide a broad, comprehensive education and generally provide within bachelor of science programs. As a minimum, the degree requires 60 credits in science and mathematics courses; at least three courses are required in mathematics and four courses are required in science courses which are not in the student's field. Bachelor of Arts in Environmental Science requires, as a minimum, 45 credits and 15 courses from the offerings in social sciences and humanities and the College of Fine Arts. For University policies concerning majors pre-

sented for the Bachelor of Arts degree, see policies which appear elsewhere in this publication under the heading, "Academic Policies: Major Field Requirements."

Bachelor of Science Degree

The Bachelor of Science degree is designed to provide a specialized education in one or more of the basic sciences. Specialized Bachelor of Science curricula which are offered in areas of science and mathematics provide opportunities for major and minor program options but afford greater opportunities for major specialization than are permitted in comparable Bachelor of Arts curricula.

All Bachelor of Science programs require, as a minimum, 74 credits and 20 courses from the offerings of the science and mathematics departments. At least three courses are required in mathematics beyond precalculus mathematics and must include two calculus courses and one additional mathematics elective.

Four science lecture courses with corequisite laboratories are required. The departmental distribution must conform to one of the following four alternatives:

1. two from each of two departments in Mathematics and Sciences;
2. four from one department in Mathematics and Sciences;
3. three from Physics and one from any department in the College of Engineering; and
4. two from Physics and two from any one department in the College of Engineering.

For University policies concerning majors presented for the Bachelor of Science degree, see policies which appear elsewhere in this publication under the heading "Academic Policies: Major Field Requirements."

Below is a list of major fields for the BS degree currently offered in the college of Arts and Sciences, division of Sciences.

Biological Science

Chemistry

Computer Science

Environmental Sciences

Mathematics

Physics

*College Policies and Requirements***General College Requirements for Science and Mathematics Students**

In order to qualify for a baccalaureate degree offered by the science and mathematics departments of the College of Arts and Sciences, undergraduates must comply with the University general education requirements, must conform to the rules of the College of Arts and Sciences which govern degree and major studies for such degrees, and must earn 2.000 averages in their major fields by the end of their senior year.

Second Majors and Minors

Options for second majors and minor studies are permitted as specified below:

1. Students may elect a second major which is offered by the College of Arts and Sciences or, upon approval of the Dean of Sciences or the Dean of Humanities and Social Sciences, they may elect a second major which is offered by other colleges of the University. But note that an English major may not declare a second major in American Studies; nor may an American Studies major choose a second major in English, history, political science, or sociology. Students who elect academic majors in more than one college are candidates for one degree only, and they are considered to be degree candidates in the college of their initial major unless they indicate to the contrary at the time they make a declaration of second major by filing for inter-collegiate transfer. Accordingly, a student who pursues academic majors in the College of Arts and Sciences and another college is subject to all degree requirements as specified by the college of his or her initial major and is subject only to major course requirements (including any collateral and prerequisite courses for the major) as specified by the department of his or her second major. For a full discussion of University requirements concerning second majors, students should consult the relevant section of this publication which appears under the heading "Academic Policies."

2. In accordance with the requirements of established minor programs, students who matriculate for degrees in the College of Arts and Sciences may undertake a minor from those areas cited below which are distinct from the disciplines comprising

their majors. The curriculum committee of the College will from time to time review and, when appropriate, approve new minors in addition to those listed below. Students should consult with their advisors concerning additions to the approved listing of minors. Specific options for minor programs will depend on the major field which a student has elected to pursue and the collateral course requirements which have been specified by their major departments. Students are advised that an aggregation of courses which total 18 or more credits does not constitute a minor area and they are referred to University policies which appear elsewhere in this publication under the heading "Academic Policies: Minor Area Requirements" for further discussion. Students who wish to elect a minor program in colleges other than the College of Arts and Sciences should refer to the appropriate section of this publication concerning prerequisites, restrictions, and prescribed sequences of courses.

American history

American literature

American studies

art history

biological sciences

chemistry

classical civilization*

clinical science**

cognitive science*

drama

economics

English general

English literature

European history

French

geology

Greek

history general

Italian studies

Latin American studies*

legal studies

mathematics (computer)**

mathematics general**

music

music history and literature

peace studies*

philosophy

physics

political science

psychology

public affairs

radiological health physics

social science

sociology

sound recording technology+

Spanish

studio art

technology, society & human values*

western cultural heritage*

women's studies*

writing

*See listing of interdisciplinary minors at the end of the College of Arts and Sciences section of this catalogue.

**Courses for a minor area in Mathematics (including the computer programming option) require approval in advance by the Chairperson of the Mathematics Department.

+Not open to majors in the social sciences and humanities.

3. With the approval of their faculty advisors, matriculating students in the College of Arts and Sciences may develop programs of elective courses for the purpose of providing greater personal and professional relevance to their major fields. Such programs may be developed from among those disciplines which are listed above as areas in which elective courses may be authorized for matriculating students of the College of Arts and Sciences.

4. Matriculating students in the College of Arts and Sciences who do not choose to take a second major or a minor must present at least six semester credits in courses which are on the "300" level among those elective courses offered in fulfillment of collateral degree requirements.

Declaring and Changing Major

Students who are matriculating for degrees in the College of Arts and Sciences are required to designate degree majors in the college. While the College of Arts and Sciences does not require students pursuing the Bachelor of Arts degree in the humanities and social sciences to declare their major fields until the end of their sophomore year, students who are admitted to Bachelor of Science programs in the sciences or mathematics are advised to declare their major fields during their freshman year and are required to make such declaration at the end of the sophomore year. Students should consult policies listed elsewhere in this publication under the heading "Academic Policies: Major Field Requirements" for a complete discussion of declaration of major, declaration of second major, change of major with intercollegiate transfer.

Language Proficiency Requirement

Students enrolled in Bachelor of Arts programs in the social sciences and humanities are required to demonstrate intermediate level proficiency in a foreign language. Students who desire to present official evidence of language proficiency for purposes of employment or application to graduate schools should consult policies noted under the heading "Academic Policies: Language Requirement" for a listing of avenues by which certification of language proficiency may be pursued.

Although the science and mathematics disciplines in the College of Arts and Sciences do not require language proficiency, each department has the prerogative of specifying a level of language proficiency as a collateral requirement for major studies. Students matriculating for the Bachelor of Science degree who major in chemistry must pass either two semesters of a foreign language at the elementary level or one semester at the intermediate level or above. Students majoring in science areas or mathematics who anticipate further studies at the graduate level are strongly advised to develop an intermediate reading proficiency in French or German.

Transfer Policies

Students transferring to the College of Arts and Sciences from other colleges of the University or from other institutions may expect recognition of previously completed college level courses which are applicable to the degree requirements of the college. The College of Arts and Sciences will not accept in transfer any professional courses from any program or curriculum whatsoever, with the exception of credits specifically applicable to the degree program in Criminal Justice. Courses of a professional nature which are not relevant to the academic orientation of humanities and social sciences programs or to the specific orientation of the degree program in Criminal Justice may not be credited to the minimum degree requirement of 120 credits, and regardless of any previous recognition by the Office of Admissions or by other colleges of the University they may not be credited to degree requirements in the College of Arts and Sciences. (Professional courses of students who transfer to the Criminal Justice Program and who subsequently seek intercollegiate transfer to another degree program in the College of Arts and Sciences will remain on the student's permanent record but will not be credited to minimum degree requirements.)

Courses from Other Institutions

Courses which are transferred from other institutions are initially evaluated by the Office of Admissions when a student is admitted to the University. Courses are evaluated by major departments in terms of college and program requirements. Courses which are transferred to the University under provisions of the Commonwealth Transfer Compact and which are not creditable to requirements of the College of Arts and Sciences or as unrestricted elective courses will be listed on the student's permanent record but will not apply to the minimum degree requirements. In the event that a student who has transferred to the University subsequently makes an intercollegiate transfer to the College of Arts and Sciences, all previously completed courses, including transferred courses from other institutions, will be reevaluated in terms of their applicability to degree requirements of the College of Arts and Sciences. The policy of the College is to count courses transferred to the major for the purpose of determining the student's major grade-point average.

Repetition of Transfer Courses

A student who has been granted transfer credit, and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite, may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred when the competence of the student has been demonstrably inadequate. Permission to repeat the transferred course is granted by filing an academic petition form through the office of the college dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

Intercollegiate Transfer to the College of Arts and Sciences

Students wishing to transfer from another college of the University or from baccalaureate continuing education programs of the evening school must file an academic petition, together with a transcript, with the appropriate chairperson and the Dean of Sciences or the Dean of Humanities and Social Sciences by Nov. 1 for spring semester transfer and by April 1 for fall semester transfer. Students are referred to University policies concerning intercollegiate transfers which appear elsewhere in this publication under the heading "Academic Policies: Change of Major with Intercollegiate Transfer" for further procedural details. Records of students who are approved for transfer are reviewed by the office of the Deans of the College of Arts and Sciences and, irrespective of grades previously received in other college programs, all courses which may not be applied to college or program requirements are deleted from the student's cumulative grade-point average.

Pre-Professional Training

The curricula for the Bachelor of Arts degree in the College of Arts and Sciences do not prescribe patterns of courses for specific vocational goals. The student in these programs receives a broad general education in the liberal arts and sciences which will prepare him/her for further study in professional and vocational fields at the graduate level. Since it is a particular

College Policies and Requirements

philosophy of the social sciences and humanities departments of the College of Arts and Sciences that a liberal education is the best preparation for further study, these departments do not recommend highly specialized courses for students planning to enter professional fields.

Law School Requirements

Pre-law work should include social sciences (especially history, economics and political science), humanities (especially literature and philosophy) and basic courses in physical sciences and mathematics. Law schools do not specify particular majors for applicants and the field of concentration is not a determinant in admissions. Law schools do, however, vary in specific requirements and the student should, therefore, become familiar with those requirements of the schools to which he or she is planning to apply. The pre-law advisor is Dr. William Burke.

Medical, Dental School Requirements

The Council and Association of American Medical Colleges have established minimum requirements for admission to an approved medical school. These include general and organic chemistry, biology, physics, and mathematics. These are minimums and many medical colleges require course work beyond the minimum. For this reason, it is imperative that a pre-medical student plan his/her college program in close consultation with the faculty advisor for pre-medical students. The advisor for pre-medical students is Dr. David Eberiel, Department of Biological Sciences, Olsen Hall.

Most medical and dental schools prefer a broad, liberal education in addition to specific course requirements. They do not advocate a particular major or majors and the field of concentration is not a determining factor in admission as long as the specified course requirements are met. Many pre-medical students will major in biology or chemistry, but a major in the areas of humanities and social sciences allow sufficient electives to meet the requirements of most schools. Medical and dental schools require an aptitude examination which is ordinarily taken in the spring semester of the junior year.

Teaching Careers

For those students interested in teaching, the College of Education offers a graduate degree program designed to prepare elementary teachers and secondary teachers in art, English, mathematics, behavioral science, history, social studies, French, Spanish, biology, chemistry, earth science and physics.

This year-long program (September to June) provides the course work and the apprentice teaching experience required for certification in Massachusetts and in thirty-three other states.

See graduate catalogue for requirements for admission.

Interested persons may obtain additional information from the Office of the Dean, College of Education.

COLLEGE OF ARTS AND SCIENCES*American Studies***American Studies**

Melissa Pennell, Coordinator

Executive Committee: Harald Bakken (History), Dean Bergeron (Regional Economic and Social Development), Mary Blewett (History), Clifford Lewis (American Studies and English), Peter O'Connell (Tsongas Industrial History Center), John Ogasapian (Music), Melissa Pennell (English). The Committee for American Studies administers a major in American Studies that leads to the Bachelor of Arts degree. The Committee also administers a minor in American Studies.

American Studies Major

American Studies allows the student who is searching for an understanding of inter-relationships among ideas, institutions, and aesthetic forms to combine a number of scholarly disciplines in order to better comprehend the many facets of American culture. By completing courses from a variety of disciplines, students in American Studies not only sharpen their analytical powers and critical insights, but will, in the long run, be well prepared for employment in education, government, social services, business, and the professions. Students who are capable of analyzing American culture by combining the conceptual approaches of a variety of disciplines - the arts, history, literature, political science, psychology, economics, sociology - are capable of making decisions with an understanding of the available alternatives. Many current problems relating to family life, medical ethics, gender and minorities, technology, the environment, international relations, government power, and the influence of business, require an interdisciplinary approach. The American Studies major is a method by which students can obtain a very broad liberal arts education. At the same time, the Committee encourages students to elect career-oriented courses as free electives. A number of American Studies majors take a portion of their free electives in management and computer programming. Because of its flexibility, the American Studies major is a good choice for students who are unsure about their ultimate career choice, for the program is flexible and allows for changes in career direction.

Major Requirements

For a major in American Studies, students must take 30-45 semester credits (with at least 15 credits at the 300 or 400 levels) including the following courses:

1. 40.248 Values in American Culture;
2. 43.305/306 American Intellectual History, or 43.313/314 American Social History;
3. an introductory research course approved by the coordinator;
4. one interdisciplinary 300 level course approved by the coordinator;
5. two courses at the 300 level or above in one discipline;
6. two courses at the 300 level or above in a second discipline; and
7. 40.401 American Studies Seminar, fall semester senior year.

Interdisciplinary Course Requirements

American Studies students must take at least one 300 level interdisciplinary course. These courses integrate a number of academic disciplines and analyze the multiplicity of forces that shape American culture.

Transfer Policy

Students transferring to the College of Liberal Arts and wishing to major in American Studies must make individual arrangements with the coordinator of the program regarding credit for major and collateral course requirements. Some introductory courses at the 100 level may be applicable to the American Studies major, but they cannot be applied to the first 30 hours of the major.

American Studies Minor

A minor in American Studies consists of 18-24 credits selected from the list maintained by the program coordinator. These courses must include either: 43.305/306 American Intellectual History; or 43.313/314 American Social History; 40.248 Values in American Culture; and at least one interdisciplinary course.

Sample Course of Study

For students entering in Fall 1993 and subsequently

Students must take 30-45 credits with at least 15 credits at the 300 or 400 level.

Freshman Year**Fall Semester**

42.101	College Writing I (Gen Ed)	3
92.	Math Req ¹ (Gen Ed)	3
	Science ¹ (Gen Ed)	3
	Beginning Language I	3
	Free Elective	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science ¹ (Gen Ed)	3
	Beh & Soc Studies (Gen Ed)	3
	Beginning Language II	3
	Free Elective	3
		15

Sophomore Year**Fall Semester**

	Values Req ² (Gen Ed)	3
	Math or Science Req ¹ (Gen Ed)	3
	History Req (Gen Ed)	3
	Intermediate Language I	3
	Literature Req (Gen Ed)	3
		15

Spring Semester

40.248	Values in American Culture	3
	Science ¹ (Gen Ed)	3
	Beh & Soc Studies (Gen Ed)	3
	Intermediate Language II	3
	Free Elective	3
		15

Junior Year**Fall Semester**

43.305	Am Intellectual Hist I ³ or	
43.313	Am Social History I ³ or	3
300	Interdisciplinary Elective ⁴	3
300/400	American Content Elective ⁵	3
	Research Methods ⁶	3
	Free Elective	3
		15

Spring Semester

43.306	Am Intellectual Hist II ³ or	
43.314	American Social Hist II ³	3

American Studies

300/400 Am Content Elective ⁵	3
Aesthetics (Gen Ed)	3
Free Elective	3
Free Elective	3
	15

Senior Year**Fall Semester**

300/400 American Content Elective ⁷	3
40.401 Senior Am Studies Seminar	3
300/400 Am Content or Free Elective	3
Free Elective	3
Free Elective	3
	15

Spring Semester

300/400 Am Content Elective ⁷	3
300/400 Am Content or Free Elective	3
Free Elective	3
Free Elective	3
Free Elective	3
	15

Notes:

1. Consult the section on Academic Policies for the General Education requirements in mathematics and sciences.
2. 59.205 Human Values in Western Culture I or 59.206 Human Values in Western Culture II are recommended to fulfill this requirement.
3. 43.305 and 43.306 American Intellectual History or 43.313 and 43.314 American Social History.
4. One interdisciplinary 300 level course approved by the Coordinator.
5. Two courses at the 300 level or above in one American discipline.
6. Students may take Research Methods in any of the following subjects: Psychology, History, Sociology or Political Science. The course may be taken in either the fall or the spring semester of the junior year.
7. Two courses at the 300 level or above in a second American discipline.

**American Studies Courses
(Prefix: 40)****40/42.248 Values in American Culture**

Deals with the development and interrelationship of American views on individualism, nature, science, technology, democracy, ethnicity, and the American dream. Readings begin with the Puritans and end with contemporary essayists. 3 cr

40/42.314 The Twenties in America

A study of the cultural and social developments in the arts, business, entertainment, government, and science and technology during the decade. 3 cr

40/42.315 The Thirties in America

A study of the influence of ideology on the cultural and social movements of the era. Included are the works of Dos Passos, Steinbeck, and Wright; and the films and photos documenting this era. 3 cr

40/42.319 The American West: Myth and Reality

A study of the American West expressed in the cultural imagination of Americans. Readings and documentaries about the arts, exploration, water resources, urban life, ethnic cultures, and feminist influences offer contrasting perspectives to the western myth. 3 cr

40/42.333 American Autobiography

A study of autobiographical writing from Colonial America to the present. Works from Franklin, Angelou, Mead, and Mangone (to cite a few) represent the pluralistic view of what it means to be an American. 3 cr

40.340 Cross-Cultural American Lit

A study of essays, fiction, poetry, and plays reflecting the multicultural American experience, with emphasis on Native-, European-, African-, Latino-/Chicano-, and Asian-American authors. 3 cr

40.335 Themes in American Civilization

A study of essays, fiction, and documentary films reflecting the aspirations of Americans including their religious, economic, political, and social perspectives with emphasis on the shaping influences of nature and science and technology. 3 cr

40.350 Contemporary Issues in American Civilization

Looks at various contemporary issues from

an interdisciplinary view. The course consists of both readings and talks from experts in the field. 3 cr

Seminar**40.401 American Studies Seminar**

A required seminar for American studies majors normally taken during the second semester of the junior year or during the senior year. Students undertake a research project leading to the writing of a major paper with a theme that combines more than one discipline. 3 cr

Directed Studies

Directed studies courses are available only to majors in American Studies and may be elected provided that 1) the material to be covered is not available in any course offered during the semester in which the directed studies course is contemplated, 2) instructors are willing to undertake a directed studies course, and 3) no more than nine credits in the major field are acquired in directed studies courses.

40.491 Directed Studies in American Studies

An investigation of a topic using an interdisciplinary approach and leading to the writing of a major paper. The course provides an opportunity for a student to work closely with an instructor on a topic of special interest. Prerequisites: 40.401 and permission of program coordinator and instructor. 3 cr

40.495 Advanced Tutorial in American Studies

A program of directed studies in which the student, in consultation with the instructor, investigates one or more topics and presents several critical essays that evaluate the readings. Prerequisites: demonstrated proficiency in the areas selected for study and permission of the instructor. 3 cr

Practicum**40.496 Practicum Experience in American Studies**

Allows students an opportunity to combine their formal education with an off campus project. After developing a proposal for the practicum under the guidance of an instructor, the student spends a major portion of his or her time dealing with persons engaged in business, the arts, the professions, community service, or government. The coordinator for American Studies maintains a file of organizations that accept students. 3 cr

Art History

Liana De Girolami Cheney, Coordinator

Professor Liana De Girolami Cheney

Art History is a humanistic discipline that is philosophically related to the liberal arts. It aims to study the arts in relation to the life and time out of which they spring from Western and non-Western cultures. It includes a comprehensive study of the historical periods, cultural expressions, aesthetic judgments, and artistic choices manifested in architecture, painting, sculpture, graphics and related processes, and artifacts from Ancient to the present. By examining the intellectual and scientific events that have shaped the creation of art and civilization, students are able to assess aesthetically and critically the artistic products of past and present cultures. Art History helps students to develop aesthetic and critical judgments as well as writing and verbal skills.

By pursuing a concentration or minor in art history students can prepare for a variety of careers in art history and related liberal art majors, such as museum researcher, museum, gallery or corporate curator, museum conservator or slide librarian, art editor and director in publishing companies, teaching, graduate studies or community oriented art programs.

Art History courses fulfill the General Education Requirement for Historical Studies and Aesthetics. The art history concentration and minor are designed to develop and foster historical and aesthetic appreciation of art as well as analytical, critical, and theoretical knowledge of art. Art history courses are taken under the auspices of the History Department.

Art History Concentration

Students enrolled in the Bachelor of Liberal Arts program may select Art History as one of their two concentrations. They must take 8 to 10 Art History courses (at least 4 at or above 300 level), selected in consultation with the Art History Coordinator and the Bachelor of Liberal Arts Coordinator.

Art History Minor

A minor in art history consists of 18 to 24 semester credits selected in accordance with the following specifications: two foundation art history courses (Survey I

and Survey II), plus 12 to 18 credits must be completed in art history courses, and no fewer than six semester credits offered for the minor shall be completed at the 300 level or above. Coursework is selected in consultation with the Art History Coordinator.

Art History Club

Provides an opportunity for all art history students to participate in field trips and conferences as well as visiting exhibition and museums in New England, New York, and Washington DC.

Internships

Open to all art history students who wish to develop special skills in museum research, curatorial experience or slide librarian apprenticeship in local museums, art corporations or private industry.

European Summer Program

Art History courses for credit are offered in various countries in Europe during the winter and summer sessions. The art history courses generally take place in England, France, Italy and Greece.

Transfer Students

Student transferring to the College and wishing to concentrate in Art History must make individual arrangements with the Art History Coordinator regarding satisfaction of art history course requirements.

Course Description (Course Prefix: 58)

58.101 Art Appreciation

The course introduces the student to the technical, aesthetic and historical aspects of architecture, sculpture and painting. An analysis of the visual elements used in fine art such as color, line, shape, texture, and value is developed through slide lectures, museum visits and assigned readings. Emphasis is placed on modes of representation, styles, media, technical procedures, and principles of design. 3 cr

58.203 Survey of Art I: Prehistoric to Medieval Art

A survey of the major Western arts from earliest time to the Middle Ages presented chronologically. Emphasis is placed upon the changing nature of the style and content within sequential cultural contexts. The aim of the course is to introduce the student to basic critical and art historical methods. 3 cr

58.204 Survey of Art II: Renaissance to Modern Art

A survey of the major Western arts from Renaissance to the twentieth century presented chronologically. Emphasis is placed upon the changing nature of the style and content within sequential cultural contexts. The aim of the course is to introduce the student to basic critical and art historical methods. 3 cr

58.205 Studies in World Art

Historical and critical examination of regions works of art from China, Asia, India, Africa, North America, Latin America, and Mexico. Topics vary from year to year. Course may be repeated. Prerequisite: permission of instructor 3 cr

58.206 History of Architecture

A survey of the major technical and stylistic developments in ecclesiastical and secular architecture from Prehistory to the present day with an emphasis on the major monuments (Parthenon, Pantheon, Gothic Cathedrals, St. Peters, Versailles Palace, Eiffel Tower, Guggenheim Museum). 3 cr

58.211 Nineteenth Century Art

A study of the nineteenth century European painting, sculpture, and architecture including the art of Neoclassicism, Romanticism, Realism, Impressionism, Post-Impressionism, Symbolism, and Art Nouveau. 3 cr

58.221 Twentieth Century Art

A study of American and European movements in painting, sculpture and architecture from 1900 to the present. Emphasis is placed on Fauvism, Cubism, Expressionism, Surrealism, International Style, Pop, Op Art, Minimal Art, Surrealism, Photorealism, and Post-Modernism. 3 cr

58.231 Greek and Roman Art

A study of Greek painting, sculpture and architecture from the Cycladic to the Hellenistic period, and an examination of Roman Art from the Etruscan Age to the beginning of Christian art. Emphasis is placed on the Greek Classical period and the Roman Empire. 3 cr

58.241 Medieval Art

A survey of architecture, sculpture and painting of Early Christian, Byzantine, Carolingian, Romanesque and Gothic periods from the fourth to the fourteen centuries in relationship to philosophical and socioeconomic developments.

Art History

Emphasis on Hagia Sophia, Aachen Chapel, Saint Denis and the French cathedrals. 3 cr

58.308 Art, Science, and Technology in the Renaissance

From Filippo Brunelleschi's first perspective experiments to Leonardo da Vinci's prolonged study of human anatomy and optics, Renaissance artists exhibited unprecedented interest in the scientific nature of light, color, space, and form as they affected artistic creativity. At no other time in history were technology, science and art so closely interconnected. Discussion will focus on the achievement of Italian artists of the fifteenth and sixteenth centuries as they attempted to translate their new scientific understanding of the world. 3 cr

58.313 American Art

The study of American painting, sculpture and architecture from the Colonial Period to the end of the nineteenth century seen in relation to European developments and American social and technological changes. Emphasis is placed on New England architecture. Prerequisite: 58-101 and/or 58-211 or permission of instructor 3 cr

58.321 Italian Renaissance Art

A study of painting, sculpture and architecture in Florence, Rome and Venice during the fifteenth and sixteenth centuries. Special emphasis on the formation of the High Renaissance style and the role of representative artists of the period: Leonardo, Michelangelo and Raphael in Central Italy; Giorgione and Titian in Venice. 3 cr

58.323 Northern Renaissance Art

Development of Flemish and Dutch painting from the brothers Jan van Eyck and Roger van der Weyden to Bosch and Bruegel, from the late fourteenth century to mid-sixteenth century. The course will also include a study of French and German painters of the same period: Fouquet, Clouet, Durer, Grunewald and Holbein. Prerequisite: 58-101 and/or 58-204 or permission of instructor 3 cr

58.330 Italian Mannerism

A study on the impact of the High Renaissance in the sixteenth century, the subsequent development of early Mannerism in central Italy and the formation of the Proto-Baroque style in Venice and Northern Italy, the establishment of the courtly Mannerist style. The role of representative artists such as Pontormo, Rosso, Parmigianino, Bronzino,

Beccafumi, Vasari, Veronese, Bandinelli, Cellini, Palladio, Peruzzi, and Ammanati is emphasized. 3 cr

58.332 Baroque Art In Italy

The development of painting, sculpture and architecture in Italy during the seventeenth century with special emphasis on Rome. The role of representative artists (Caravaggio, Bernini, Borromini, Pietro da Cortona) is emphasized. Prerequisite: 58-101 and/or 58-204, 58-321 or permission of instructor 3 cr

58.334 Northern Baroque Art

The examination of seventeenth century painting outside Italy with emphasis on Dutch, Flemish, Spanish and French Art. The role of representative artists of the period (Rembrandt, Rubens, Velazquez and Poussin) is emphasized. Prerequisite: 58-101 and/or 58-204, 58-323 or permission of instructor 3 cr

58.340 Women and Art

Investigation of the various ways women have been portrayed in the visual arts from antiquity to the present. A chronological examination of selected female artists and their milieu from the Middle Ages to the twentieth century. Prerequisite: 58-101 and/or 58-203, 58-204 or permission of instructor 3 cr

58.345 The Pre-Raphaelites

The examination of nineteenth century painting in England with a study on the role of representative artists such as Ford Madox Brown, Dante Gabriel Rossetti, John Everett Millais, Edward Burne-Jones, William Holman Hunt, Elizabeth Siddall, Fredrick Sandys, and William Morris. Prerequisite: 58-101 and/or 58-204, 58-211 or permission of instructor 3 cr

58.350 Post-Modernism in Art and Architecture

The course will explore crucial issues of contemporary art, examining in detail particular artists, art forms, and critical concepts. The study will cover art movements from the 1960's to present in painting, sculpture, and architecture. Prerequisite: 58-221 or permission of instructor 3 cr

58.352 Critical Issues: History of Art Theory and Criticism

Examination of issues of content, theory, and criticism in traditional, modern and contemporary art. Topics vary from year to year. 3 cr

58.490 Art History Seminar

Study of particular artist, style or selected

art historical problem. Topics to be announced. Course may be repeated. Prerequisite: permission of art history instructor 3 cr

Directed Study

Directed study courses are available only to art history students and may be elected provided that (1) the material to be covered is not available in departmental course offerings, (2) art history instructor is willing to undertake a directed studies course, and (3) no more than six hours of credit in the major field is acquired through registration for a completion of directed studies courses.

58.494 Directed Study in Art History

An individual supervised research project relating to stylistic, thematic or methodological issues in Art History, the result to be presented in a significant paper. Prerequisite: permission of art history instructor 3 cr

58.495 Advanced Tutorial in Art History

A program of directed studies which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate and investigate an additional problem. The purpose is to sharpen and refine skills for scholarly research and presentation. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of art history instructor 3 cr

58.496 Practicum Experience in Art History

A program of on-campus and/or off-campus experiences for art history students only. Specific requirements will vary depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural or artistic area and for applying techniques of problem solving and/or credits. Students will be graded "satisfactory" or "unsatisfactory." Prerequisite: permission of the Art History Coordinator or supervising art history instructor. 3 cr

Department of Biological Sciences

Robert D. Lynch, Chairperson

Professors: Robert M. Coleman (Emeritus), David T. Eberiel, Jerome Hojnacki, Ethel Kamien (Emerita), Robert D. Lynch, John C. Mallett, Thaddeus V. Osmoski, Ezequiel Rivera, Robert H. Tamarin

Associate Professors: Siu-Lam Lee, John F. Lyon (Emeritus), Thomas B. Shea, Ilze B. Skare

Assistant Professors: Garth F. Hall, Susan J. Braunhut, Prentiss Shepherd (Emeritus)

Biological Sciences Major

Students majoring in Biological Sciences prepare for a variety of careers which contribute to our understanding of basic life processes and the solution of problems related to health and the environment. Many of those graduating with their Bachelors degree are employed by institutions involved in bio-medical research or environmental field studies, while others become science educators. Degree recipients often choose to continue their education in professional (medical, veterinary, dental) schools or by matriculating into masters and doctoral programs. Since their training in science is integrated with an education in humanities and social sciences, graduates are not only prepared to excel in expanding the base of knowledge in their field of expertise, but are able to understand and respond to social and ethical issues arising from these advances.

The undergraduate program insures a strong foundation in supporting science and mathematics and provides the essential background needed for a career in modern biology. A wide variety of upper-level electives are available, and the curriculum is sufficiently flexible so that students may tailor it to meet specific career goals and entrance requirements of professional schools and postgraduate programs. Although it is not required, qualified seniors are encouraged to conduct original research as a capstone to their undergraduate experience. Enrolling in Senior Research provides graduation credits, but more importantly, many of these projects have resulted in a student's first

publication in a professional journal or have been presented at scientific meetings.

The Biotechnology Option is an additional opportunity open to biology majors. Undergraduates choosing this curriculum complete a set of advanced courses designed to provide the conceptual background and practical training appropriate to develop exciting and lucrative careers in applied biology: genetic engineering, industrial microbiology, cell culture technology, and the manufacture and purification of diagnostics and other biologically relevant materials. Students can integrate course offerings from the departments of Chemistry and Earth Sciences as well as Chemical, Plastics and Civil Engineering, into the design of their major program.

Many students in Biological Sciences take advantage of the unique resources of several Research Centers that are affiliated closely with the Department of Biological Sciences. The Centers for Neurobiology, Bioprocess Development, Polymer Biodegradation, and Tropical Diseases offer courses and/or research opportunities to qualified undergraduates.

The Honors Program.

Students admitted to the Honors College, as well as those whose academic performance is consistently at a high level, are invited to enroll in special sections of required and elective courses. These sections promise an enhanced learning experience and/or an amplification of the subject matter presented in the regular sections. Modes of examination and course requirements may differ as well. The Department of Biological Sciences provides several Honors courses. Exceptional students may also avail themselves of "Honors Supplements" to many of the other departmental offerings. These generally investigate a subject in greater depth and/or breadth and may include additional meetings with the instructor, augmented course assignments, an independent project, or a combination of these. Successful completion of such courses will earn honors credit and will be so designated on the University transcript.

Pre-Health Professional Training

Curricula in the Department of Biological Sciences satisfy entrance requirements for

schools of medicine, dentistry, veterinary medicine, osteopathic medicine, optometry, podiatry and chiropractic. Students who anticipate application to professional schools should register as soon as possible with the pre-health professional advisor who, along with a university-wide committee, will counsel them and provide important guidance with respect to the professional school admissions process.

Other Programs Supported by Biological Science

In addition to meeting the needs of students majoring in Biological Sciences, the Department offers courses to others who have elected the Biology focus in the Environmental Sciences program or who are pursuing a degree in bio-medical aspects of Radiological Sciences. Specialized upper level courses are also available to qualified students majoring in other science, health, and engineering programs throughout the University.

Post-Graduate Programs in Biological Sciences

The following is a summary of post-graduate training available in the Department of Biological Sciences. For more detailed information, please consult the Graduate School Catalog or request specific information from the Department Office.

Graduate Certificate in Biotechnology and Bioprocessing

This certificate, offered jointly by the Departments of Biological Sciences and Chemical Engineering, will be of special interest for those seeking employment in the biotechnology industry. These multidisciplinary courses in fermentation, cell cultivation and protein purification bridge the gap between research and manufacturing, and add breadth to the students' background, preparing them for leadership roles in biopharmaceutical project teams. Three of the four courses required for certification are offered by the Massachusetts Bioprocess Development Center. The fourth may be any of several approved biotechnology electives available within both departments. With careful planning, a student receiving the Bachelor's degree in Biology or Chemical Engineering may complete requirements for the Graduate

Department of Biological Sciences

Certificate on a full or part time basis during the summer and fall semesters following graduation. Note that credits earned for the certificate can be applied toward the total credits (30) needed to satisfy requirements for the M.S. degree in Biological Sciences.

Five Year B.S./M.S. Program

An accelerated five-year course of study leading to the B.S. and M.S. degrees in Biological Sciences is available. Interested students, after evaluation and acceptance by the Department's graduate selection committee, are assigned an advisor to assist them in designing a plan for completion of requirements for both degrees within a five-year time frame. It should be noted that credit received for courses taken to complete requirements for the Graduate Certificate in Biotechnology and Bioprocessing can be applied toward the total credits needed to complete the Five Year B.S./M.S. Program.

M.S. and Doctoral Programs

The objective of these programs is to foster critical thinking and to develop skills needed for independent laboratory study. This is accomplished, in part, by offering advanced lecture, seminar and laboratory courses. While it is possible to complete M.S. requirements without thesis or project option it is this latter activity that most distinguishes graduate from undergraduate students. All full-time M.S. degree students are, therefore, strongly urged to elect thesis or project options. The Department of Biological Sciences also collaborates with the Department of Chemistry in offering the Ph.D. Option in Biochemistry. Laboratory thesis research is a required component of this program.

Research in the Department of Biological Sciences

Eligible undergraduate and graduate students interested in research are encouraged to meet with research faculty as early in their program as possible in order to identify topic areas of interest. The principal areas of research in this department are in molecular and cell biology, biotechnology, biochemistry and environmental biology. In addition to research programs within the Department, there are interest-

ing projects on-going in the Massachusetts Bioprocess Development Center, the Center for Tropical Diseases, the Center for Environmentally Appropriate Materials, and the Polymer Degradation Laboratory. Once students have chosen a laboratory in which they would like to work, it is important for them to obtain permission from the responsible faculty member to join that laboratory. While faculty enjoy having students work in their laboratories, there is a limit to the number of students who can be accommodated by any professor. It is a good idea, therefore, to select a number of projects so that, if one laboratory is filled, there are alternatives. There is no guarantee that all students seeking laboratory research experience will be accommodated.

Degree Requirements (Biological Sciences)**I. General Education Guidelines (24 credits)**

Students must conform to the General Education guidelines as outlined elsewhere in this document. These include one year of College Writing and the distribution of six additional electives among behavioral and social science (two courses), aesthetics, historical studies, literature, and human values (one course each).

II. Major Field Requirements**A. Designated Biological Sciences 31 cr**

81.111 Principles of Biology I	3 cr
81.113 Principles of Biology I Lab	2 cr
81.115 Freshman Seminar	1 cr
81.112 Principles of Biology II	3 cr
81.114 Principles of Biology II Lab	2 cr
81.116 Freshman Seminar	1 cr
81.201 General Microbiology	3 cr
81.203 General Microbiology Lab	1 cr
81.252 Physiology	4 cr
81.335 Principles of Genetics	3 cr
81.337 Principles of Genetics Lab	1 cr
81.419 Biochemistry	3 cr
81.421 Techniques in Biochemistry	2 cr
81.451 Senior Sem in Adv Topics I	1 cr
81.452 Senior Sem in Adv Topics II	1 cr

B. Supporting Sciences & Math 35 cr

84.121 Chemistry I	3 cr
84.123 Chemistry I Lab	1 cr
84.122 Chemistry II	3 cr

84.124 Chemistry II Lab	1 cr
84.221 Organic Chemistry IA	3 cr
84.229 Organic Chemistry Lab IA	1 cr
84.222 Organic Chemistry IIA	3 cr
84.230 Organic Chemistry Lab IIA	1 cr
92.131 Calculus I or	4 cr
92.127*Calculus IA and	4 cr
92.128*Calculus IB	4 cr
92.183 Intro to Stats(or substitute)	3 cr
95.201 Principles of Physics I (or substitute)	3 cr
95.202 Principles of Physics II (or substitute)	3 cr
96.103 Gen Experimental Physics I	1 cr
96.104 Gen Experimental Physics II	1 cr

*Calculus IA & IB, combined, earn only 4 credits for graduation.

III. Option Requirements**A. Biology Option 14 cr**

Two semesters of senior research or two full-time upper level biology courses with a laboratory component, as well as two additional full-time upper level courses.

Electives (free + designated) excluding courses with an "83" prefix and mathematics courses below the level of Calculus I. 14-18 cr

B. Biotechnology Option

(20 credits minimum)

Required Upper Level Courses 14 cr

81.467 Recombinant DNA Tech	3 cr
81.469 Recombinant DNA Tech Lab	2 cr
81.476 Cell Culture	2 cr
81.478 Cell Culture Laboratory	2 cr
81.493 Immunology	3 cr
81.495 Immunology Laboratory	2 cr

Designated Biotechnology Electives 6 cr

A minimum of two courses must be selected from an approved list that include:

81.420 Biochemistry II	3 cr
81.535 Cell & Microbe Cultivation*	3 cr
81.545 Isolation & Purification Biotech Products*	3 cr
81.586 Biotechnology Processing Projects Lab*	3 cr
81.558 Industrial Microbiology	3 cr
81.472 Virology	3 cr
81.474 Virology Laboratory	1 cr
81.442 Cell Biology	3 cr
81.563 Electron Microscopy	4 cr

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84.339 Physical Chem Principles	3 cr
84.341 Physical Chem Princ Lab	1 cr
84.313 Analytical Chemistry I	3 cr
84.315 Analytical Chemistry I Lab	1 cr
84.314 Analytical Chemistry II	3 cr
84.316 Analytical Chemistry II Lab	1 cr
84.526 Theory & Practice of Chromatography	3 cr

*Open to seniors with permission of instructor.

IV. Additional Courses (0-12 credits)

A minimum of 120 credits is required for the Bachelor's Degree. Free electives may be selected from the offerings of any department of the University with the exception of Mathematics courses below the level of Calculus IA and courses designated by the Department of Biological Sciences for non-majors all of which have an "83" prefix.

As part of the 120 credits required for graduation, all students in Bachelor of Science programs must earn at least 74 credits in a minimum of 20 courses offered by the College of Arts and Sciences.

Biological Sciences Minor

A minor in Biological Sciences consists of the following:

1. Two semesters of college-level introductory biology with a laboratory component. This requirement may be satisfied by electing the lecture and laboratory sections in either the Principles of Biology or Life Science courses.
2. Four additional three- or four-credit courses with an "81" prefix offered by the Department of Biological Sciences. Two of these courses must have a laboratory component. At least six credits must be at the 300 level or above.

Sample Course of Study

For students entering in Fall 1993 and subsequently

Freshman Year**Fall Semester**

81.111 Principles of Biology I	3
81.113 Principles of Biology Lab I	2

81.115 Freshman Seminar in Biology I	1
84.121 Chemistry I	3
84.123 Chemistry I Lab	1
42.101 College Writing I (Gen Ed)	3
	13

Spring Semester

81.112 Principles of Biology II	3
81.114 Principles of Bio Lab II	2
81.116 Freshman Seminar in Biology II	1
84.122 Chemistry II	3
84.124 Chemistry II Lab	1
92.131 Calculus I	4
42.102 College Writing II (Gen Ed)	3
	17

Sophomore Year**Fall Semester**

81.201 General Microbiology	3
84.203 General Microbiology Lab	1
84.221 Organic Chemistry I-A	3
84.229 Organic Chemistry I-A Lab	1
92.132 Calculus II	4
Beh & Soc St (Gen Ed)	3
	15

Spring Semester

81.252 Physiology	3
81.254 Physiology Lab	1
84.222 Organic Chemistry II-A	3
84.230 Org Chemistry II-A Lab	1
Statistics Elective	3
Beh & Soc St (Gen Ed)	3
	14

Junior Year**Fall Semester**

81.419 Biochemistry	3
81.335 Principles of Genetics	3
81.337 Principles of Genetics Lab	1
College Level Physics I	3
College Level Physics Lab I	1
Historical Studies (Gen Ed)	3
	14

Spring Semester

81.421 Tech in Biochemistry	2
College Level Physics II	3
College Level Physics Lab II	1
81.3/4 Biology Elective	3
Literature (Gen Ed)	3
Free Elective	3
	15

Senior Year**Fall Semester**

81.451 Sr Seminar in Adv Topics	1
81.311 Senior Research or	
81.3/4 Biology Elective w/Lab	4
81.3/4 Biology Elective	3
Values, C & C (Gen Ed)	3
Free Elective	3
	14

Spring Semester

81.452 Sr Sem in Adv Topics	1
81.412 Senior Research or	
81.3/4 Biology Elective w/Lab	4
81.3/4 Biology Elective	3
Aesthetics (Gen Ed)	3
	11

**Sample Course of Study
Biotechnology Option**

For students entering in Fall 1993 and subsequently

Freshman Year**Fall Semester**

81.111 Principles of Biology I	3
81.113 Principles of Biology I Lab	2
81.115 Freshman Bio Seminar	1
84.121 Chemistry I	3
84.123 Chemistry I Lab	1
42.101 College Writing I (Gen Ed)	3
	13

Spring Semester

81.112 Principles of Biology II	3
81.114 Principles of Biology II Lab	2
81.116 Freshman Bio Seminar	1
84.122 Chemistry II	3
84.124 Chemistry II Lab	1
92.131 Calculus I	4
42.102 College Writing II (Gen Ed)	3
	17

Sophomore Year**Fall Semester**

81.201 General Microbiology	3
81.203 General Microbiology Lab	1
84.221 Organic Chemistry I-A	3
84.229 Organic Chemistry I-A Lab	1
92.132 Calculus II	3
Beh & Soc St (Gen Ed)	3
	14

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Spring Semester

81.252	Physiology	3
84.222	Organic Chemistry II-A	3
84.230	Organic Chemistry II-A Lab	1
	Statistics Elective	3
	Beh & Soc St (Gen Ed)	3
		13

Junior Year**Fall Semester**

81.419	Biochemistry	3
81.335	Prin of Genetics	3
81.337	Prin of Genetics Lab	1
	College Level Physics I	3
	College Level Physics Lab I	1
	Historical Studies (Gen Ed)	3
		14

Spring Semester

81.421	Techniques in Biochemistry	2
81.476	Cell Culture	3
81.478	Cell Culture Lab	1
	College Level Physics II	3
	College Level Physics Lab II	1
81.	Biotechnology Elective	3
	Literature (Gen Ed)	3
		16

Senior Year**Fall Semester**

81.451	Sr Seminar in Adv Topics	1
81.495	Immunology Lab	2
81.467	Recombinant DNA	3
81.469	Recombinant DNA Lab	2
81.	Biotechnology Elective	3
	Values, C & C (Gen Ed)	3
		14

Spring Semester

81.452	Sr Seminar in Adv Topic	1
81.	Biotechnology Elective	4
81.	Biotechnology Elective	4
	Aesthetics (Gen Ed)	3
	Free Elective	3
		15

Biology (Course Prefix: 81)

Courses designed primarily to satisfy the requirements of students majoring or minoring in Biological Sciences; they may also serve as electives for others with specialized interests.

81.111 Principles of Biology I

Designed for students intending to pursue careers in the biological sciences, biotechnology or related areas such as medicine, biomedical research, radiological sciences or environmental sciences. This is the first course of a two semester sequence which introduces such topics as the chemical and physical basis of life, its evolution, diversity and distribution, as well as the interrelationships between life forms. The central theme of gene replication, translation, expression and selection will be emphasized as a unifying principle which determines and integrates structure and function at the cell, individual, population and community levels of organization. Corequisite: I,(3,0)3

81.112 Principles of Biology II

A continuation of the 81.111 in which students are introduced to such topics as molecular energy exchange in organisms (photosynthesis and respiratory metabolism). The common functional needs of support, locomotion, nutrition, internal communication and the maintenance of homeostasis are considered. Control and regulation of organisms at levels beyond the individual are considered through discussions of population and community ecology. Corequisite: 81.116 II(3,0)3

81.113 Principles of Biology I Laboratory

A series of field trips and laboratory exercises designed to introduce the student to concepts of the distribution and maintenance of life. Specific consideration is given to the diversity and organization of local ecosystems; the continuation of life is considered through exercises covering mitosis, meiosis, genetics and evolutionary biology. A weekly one-hour pre-laboratory recitation is an integral component of the course. I(1,3)2

81.114 Principles of Biology II Laboratory

A series of laboratory experiments, analyses and exercises designed to introduce students to biological techniques and processes at the sub-cellular, cellular and organ systems levels. A weekly one-hour pre-laboratory recitation is an integral component of the course. II(1,3)2

81.115, 81.116 Freshman Seminar in Biology (Honors section available)

This course offers a small group seminar format for problem solving and discussion

with faculty and staff. It is designed for individual participation in exploring concepts related to material considered in Principles of Biology I and II (81.111 and 81.112). Required of freshman students; optional, with permission of instructor, to others registered in lecture section. Corequisite: 81.111 or 81.112 I,II(1,0)1

81.201 General Microbiology (Honors section available)

A study of the general properties of bacteria and viruses (anatomy, physiology, genetics, metabolism, cultivation, and growth); discussions include major microbial infections in man (etiologic agent, antibiotics and chemotherapy) and an examination of the role of the microbes in the environment. Prerequisites: 84.122, 81.111 and 81.112. Corequisite: 81.203 I(3,0)3

81.203 General Microbiology Laboratory

A series of laboratory exercises covering basic qualitative and quantitative techniques commonly employed in a microbiology laboratory. Corequisite: 81.201 I(0,3)1

81.215 Introduction to Marine Biology

An introduction to the marine environment with major consideration given to the biological and ecological aspects. Emphasis is on the flora and fauna of New England. Several field trips are required. Corequisite: 81.217 (2,0)2

81.217 Intro to Marine Biology Laboratory

A series of laboratory exercises and field trips designed to emphasize the material covered in 81.215 (0,3)1

81.224 Intro to Insect Biology

A survey of the major groups of insects. Topics include their structures, importance, and relationship to man. Prerequisites: 81.111, 81.112 or Life Science Corequisite: 81.226 (2,0)2

81.226 Intro to Insect Biology Laboratory

A series of laboratory studies on the structures, diversity, and collection techniques of insects. Corequisite: 81.224 (0,2)1

81.252 Physiology

A series of lectures, laboratory exercises and/or library projects which introduce stu-

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dents to the fundamental mechanisms governing mammalian physiology. The role of cell physiology in determining systemic functions and coordinating biological control systems will be emphasized.

Maintenance of homeostasis will be discussed in terms of biochemical, cytological, anatomical and physical principles. II(4,0)4

81.306 Invertebrate Zoology

A survey of the phyla of invertebrate animals. Discussions include their physiology, development, morphology, behavior, ecology and adaptations. Corequisite: 81.308 (3,0)3

81.308 Invertebrate Zoology Laboratory

A broad spectrum of living and preserved specimens are studied in the laboratory with regard to both structure and function. Corequisite 81.306 (0,3)1

81.315 Principles of Ecology

A series of lectures concerned with the interrelationships of organisms with their abiotic environment with emphasis on the New England area. Selected current topics will supplement the text. Prerequisites: 81.111, 81.112, 81.113 and 81.114 Corequisite: 81.317 I(2,0)2

81.317 Principles of Ecology Laboratory

A series of laboratory exercises to supplement and illustrate lectures of 81.315. Field trips are an integral part of the course involving sampling and analysis of such ecosystem components as water, soil, invertebrate fauna and characteristic flora of various habitats. Directed readings, quizzes, practical exam and oral presentation of a research topic are integral parts of the course. Corequisite: 81.315 I(0,4)2

81.320 Botany

An introduction to the study of the plant kingdom dealing with the structure, function and diversity of plants with an emphasis on seed plants. The physiology, morphology, and taxonomy of plants is emphasized. Corequisite: 81.322 (3,0)3

81.322 Botany Laboratory

Field and laboratory exercises designed to emphasize material covered in 81.320. Corequisite: 81.320 (0,3)1

81.327 Histology

An introduction to the microscopic structure of animal tissues with emphasis upon

human histology. Laboratory investigation is an integral part of the course.

Prerequisites: 81.111, 81.112, 81.113 and 81.114 Corequisite: 81.329 (3,0)3

81.329 Histology Laboratory

A series of laboratory exercises designed to emphasize the material covered in 81.327 Corequisite: 81.327 (0,3)1

81.335 Principles of Genetics

The theories of both classical and molecular genetics are explored with emphasis on the experimental evidence which has laid the foundation for contemporary understanding of genetics. Included is the nature of the genetic material, gene action, genetic recombination, gene regulation, gene interaction, the production and inheritance of genetic phenotypes, chromosomal mechanics, and the behavior of genes in populations. Prerequisites: 81.111, 81.112, and 84.222 I(3,0)3

81.337 Principles of Genetics Laboratory

Laboratory investigations of the transmission and expression of morphological and physiological characters in both eukaryotic and prokaryotic organisms. I(0,3)1

81.342 Comparative Vertebrate Anatomy

A study of the basic similarities and differences of organ systems in the vertebrates with reference to the fields of embryology, histology, and paleontology. Representative vertebrates are studied in the laboratory. Prerequisites: 81.111, 81.112, 81.113, and 81.114 Corequisite: 81.344 (3,0)3

81.344 Comparative Vertebrate Anatomy Laboratory

A series of exercises designed to emphasize the material covered in 81.342. Corequisite: 81.342 (0,4)2

81.347 Human Nutrition

Emphasizes fundamental physiological and biochemical principles of human nutrition. A basic course in physiology is a prerequisite. Students will have an opportunity to compare their present dietary practices with recommended dietary allowances, goals and guidelines. Nutrient excesses and inadequacies during various stages of the life cycle (pregnancy, infancy, childhood, adolescence, adulthood, old age) will be considered. Current concepts and controversies in nutrition research,

surveys, and methods will also be evaluated. (3,0)3

81.401,402 Biology Practicum I, II

Through observation, preparation of material and presentation of demonstrations in selected courses offered by the Department of Biological Sciences, the student becomes familiar with the materials and teaching/learning situations in biology. I,II(0,6)2

81.411,412 Senior Research in Biology

An individual, directed one-year research program for senior biology majors selected on the basis of previous academic performance at the end of the junior year. A topic will be chosen after consultation with a faculty member. A report of the research in the form of a thesis is required. Students may not receive credit for either 81.411 or 81.412 alone. I,II(0,12)4

81.419 Principles of Biochemistry I (Honors section available)

A study of the structure and properties of proteins, carbohydrates, and lipids which, combined with a discussion of elementary enzymology, allows for detailed descriptions of several important degradative and biosynthetic pathways, their integration and regulation. Throughout the course, emphasis is on methods and practical application of fundamental information to the solution of problems of current biomedical interest. Prerequisite: 84.221 Recommended: 84.344 I(4,0)3

81.420 Principles of Biochemistry II

A continuation of 81.419 which will include the following topics: a) biosynthesis and degradation of amino acids, purine and pyrimidine nucleotides, and regulation of these metabolic pathways, b) structure and function of chromatin DNA and RNA, and c) mechanism of DNA, RNA and protein biosynthesis and regulation of gene expression. Prerequisite: 81.419 II(3,0)3

81.421 Techniques of Biochemistry

A series of discussions and "hands on" laboratory exercises emphasizing techniques and use of equipment most commonly employed in biochemical-biomedical research laboratories. Techniques to be mastered include: cell culture, cell fractionation, enzyme purification, ultracentrifugation, UV-visible spectrophotometry, spectrofluorometry, various types of chromatography (thin layer, gas, gel exclusion,

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ion exchange), electrophoresis, liquid scintillation spectrometry, and the safe handling and application of radioisotopes to problems in biochemistry. Wherever possible, the principles presented in 81.419 will be used as a basis for experimentation using the above techniques. Prerequisite: 81.419 or the equivalent II(1,4)2

81.442 Cell Biology

Deals with the study of the cell and its cytoplasm incorporating the structure of cell membranes and the organelles they define; specialized organelles dealing with energy capture and transduction, some aspects of histochemical and biochemical studies on cytoplasmic organelles at the electron microscopic level. An introduction into cytogenetics and nuclear cytology; a brief discussion of prokaryotic cells. Prerequisites: 81.419 and permission of instructor. Corequisite: 81.444 (3,0)3

81.444 Cell Biology Laboratory

Introduction to the optical microscope as an analytical tool. Individual laboratories using a variety of instruments designed to acquaint the student with the analysis of cells. Analysis of biological ultrastructure at the optical and electron microscopic level. Corequisite: 81.442 (0,3)1

81.451,452 Senior Seminar in Advanced Topics

Seminar discussion of selected topics of current research interest. An oral seminar presentation as well as a written report are required of all biology seniors. I,II(1,0)1

81.467 Recombinant DNA Techniques

A study of the principles and specialized techniques of cloning, purifying, and manipulating recombinant DNA molecules. Prerequisites: 81.335, 81.419, and permission of instructor. Corequisite: 81.469 I(3,0)3

81.469 Recombinant DNA Techniques Laboratory

Laboratory experiments and independent projects designed to illustrate current techniques and instrumentation used in genetic engineering. Included are restriction mapping, cloning, plasmid purification, blot hybridization, PCR, and DNA sequencing. Students are introduced to computer software utilized for DNA sequence analysis and manipulation. Corequisite: 81.467 I(1,4)2

81.472 Virology

A study of bacterial, animal, and plant viruses, including viral structure, modes of replication, biochemistry of the infected cell, genetic properties, and viral oncogenesis. Emphasis is on virus-cell interaction at the molecular level. Prerequisites: 81.335 and 81.419 II(3,0)3

81.474 Virology Laboratory

Experiments with bacterial and animal viruses including lytic virus propagation and titrating, biochemical, biophysical, and genetic analysis of viral nucleic acids and proteins, and cell culture techniques. Prerequisite/corequisite: 81.472 II(0,4)1

81.476 Cell Culture

Lectures and readings on the biology and culture of animal and plant cells in vitro. Students are introduced to methodologies utilized in employed biomedical research laboratories as well as the biotechnology industry. Prerequisite: 81.335, 81.419 (and 81.493 or permission of instructor). Corequisite: 81.478 II(2,0)2

81.478 Cell Culture Laboratory

A series of exercises demonstrating the principles presented in 81.476. Techniques will include: media preparation, standard culture procedures. Corequisite: 81.476 II(0,4)2

81.491,492 Senior Project in Biology

Individual, directed one semester research project taken in the fall and/or spring. Presentation of an acceptable project plan at the time of registration is required. A project report is required. I,II(0,12)4

81.493 Immunology

A study of the nature of the immune response with sections on antibody structure, function and production; antigen-antibody reactions; immunogenetics; and immune regulation, protection and injury. Prerequisites: 81.335 and 81.419 I(3,0)3

81.495 Immunology Laboratory

A series of basic laboratory exercises dealing with the preparation, isolation and characterization of antigens, antibodies and effector cells. I(1,4)2

81.496 Practicum Experience

On-campus and/or off-campus experiences are developed by the student in consultation with a member of the student's major department. Specific requirements will vary depending upon department

policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a scientific area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of department chairperson. I,II(0,9)3

Graduate Biology Courses

The following 500-level courses are primarily for graduate students, but are open to qualifying undergraduate students with instructor's permission.

81.500 Professional Internship

Credits will be given to individuals who present evidence of having at least one full year of experience in an academic, hospital, or industrial laboratory setting, or in secondary school science teaching. I,II(3,0)3

81.501,502 Selected Topics in Biology

Current topics in various fields of biology presented in lecture, seminar or discussion groups. Subject matter may vary depending on interests of instructor and needs of students. May be repeated for credit when course content differs. I,II(3,0)3

81.510 Limnology

Introduction to freshwater environment considering geology, chemistry and physics of waters as they affect flora and fauna in standing and flowing water. Attention is addressed to basin and channel morphometry, thermal, photic, hydrologic and solvent properties of the medium. Prerequisites: 81.111, 81.112 and Ecology (3,0)3

81.525 Neurobiology

Textbook readings of advanced neuronal cell biology topics are expanded upon by discussion of current journal publications, and guest lectures by internationally recognized neuroscientists. Topics include aspects of signal transduction, cytoskeletal assembly, development of polarity, cell-cell signaling, and development. The relationship between errors in these processes and the events leading to several human neurodegenerative conditions is explored. In addition to gaining expertise in contemporary neurobiology, students learn how to

critically analyze current hypotheses and research methodologies as published in leading journals. I,(3,0)3

81.535 Principles of Cell and Microbe Cultivation

Cultivation of recombinant and non-recombinant mammalian cells and microorganisms. Prerequisite: Senior status in biology, chemistry or chemical engineering and permission of instructor. (3,0)3.

81.541 Advanced Topics in Cell Biology and Physiology

Structure and function of the cell: a) cellular membranes, b) transport mechanisms, c) motility, d) excitable cells, and e) energy transduction mechanisms. May be repeated for credit when content varies. Prerequisite: 81.419 (3,0)3

81.542 Cell Biology

Ultrastructure and biochemistry of eukaryotic cells; cell membranes and organelles; energy capture and transduction; histochemical and biochemical studies of organelles at the optical and electron microscopic level; cytogenetics; brief discussion of prokaryotic cells. A substantial library investigation is required. Prerequisite: 81.419 or equivalent Corequisite: 81.544 (3,0)3

81.544 Cell Biology Laboratory

The use of the optical microscope as an analytical tool. Analysis of biological ultrastructure at the optical and electron microscopic level. Cell fractionation. Chromosome preparations. One substantial ultrastructural analysis required. Corequisite: 81.542 (0,3)1

81.545 Isolation and Purification of Biotech Products

Efficient isolation and purification of biological products, especially proteins, from complex natural mixtures. Prerequisite: Senior status in biology, chemistry or chemical engineering and permission of instructor. (3,0)2.

81.548 Principles of Biochemistry I

Primarily for M.S. students in biological sciences. Lecture and text assignments on the subjects of protein, carbohydrate, lipid, enzyme and membrane biochemistry will be supplemented with research journal readings. Prerequisite: 84.222 Recommended: 84.344 I(4,0)3

81.549 Principles of Biochemistry II

This course is a continuation of 81.519 and will include discussions on all aspects of amino acid and nucleic acid metabolism and protein biosynthesis. II(3,0)3

81.554 Techniques in Biochemistry

Emphasis on common techniques and instrumentation employed in modern research laboratories. Prerequisite/corequisite: 81.419 or equivalent Required of M.S. students in the Biotechnology Option II(1,4)2

81.558 Industrial Microbiology

Selected topics concerned with the use of microorganisms for the production of substances of economic importance. The principles and techniques of fermentation to produce such products as amino acids, antibiotics, vitamins, and organic acids are addressed with emphasis on metabolic regulation of biochemical pathways and genetics of industrially important microorganisms. Prerequisite: 81.419 or equivalent II(3,0)3

81.563 Electron Microscopy - Theory and Practice

Introduction to electron optics and electron microscopes. Preparation of biological samples for electron microscopy. Operation of electron microscopes. Project required of all students. Prerequisites: 81.419 or equivalent, and permission of instructor (2,6)4

81.567 Recombinant DNA Techniques

A study of the principles and specialized techniques of cloning, purifying, and manipulating recombinant DNA molecules. A term paper or seminar may be required. Prerequisites: 81.335, 81.419 and permission of instructor. Corequisite: 81.569 I(3,0)3

81.569 Recombinant DNA Techniques Laboratory

Laboratory experiments and independent projects designed to illustrate current techniques and instrumentation used in genetic engineering. Included are restriction mapping, cloning, plasmid purification, blot hybridization, and DNA sequencing. Students are introduced to computer software utilized for DNA sequence analysis and manipulation. Corequisite: 81.567 I(1,4)2

81.572 Virology

A study of bacterial, animal, and plant

viruses, including viral structure, modes of replication, biochemistry of the infected cell, genetic properties, and viral oncogenesis. Emphasis is on virus-cell interaction at the molecular level. II(3,0)3

81.574 Virology Laboratory

Experiments with bacterial and animal viruses include lytic virus propagation and titrating; biochemical, biophysical, and genetic analysis of viral nucleic acids and proteins; and cell culture techniques. II(0,4)1

81.576 Cell Culture

Lectures and readings on the biology and culture of animal and plant cells in vitro. Students are introduced to methodologies employed in basic biomedical research laboratories as well as the biotechnology industry. A term paper or seminar is required. Prerequisites: 81.335, 81.419 and 81.493 Corequisite: 81.578 II(2,0)2

81.578 Cell Culture Laboratory

A series of exercises demonstrating the principles presented in 81.576. Techniques will include: media preparation, and standard culture procedures, and hybridoma methodology. Corequisite: 81.576 II(1,4)2

81.580 Developmental Biology

An in depth discussion of contemporary topics related to reproduction and embryogenesis. Lecture material is supplemented with reading assignments in a recently published text book and current literature taken from research journals. Emphasis is on the dynamic nature of the interactions between developing cells as well as the events that occur during fertilization, implantation and the development of the mammalian embryo which lead to birth. Students examine how studies with non-mammalian model systems such as *Drosophila* and *Xenopus* have enhanced our knowledge of mammalian development. Among the topics discussed are the role of adhesion molecules, HOX genes, apoptosis, hypomethylation of genes, axis formation and hormonal control of differentiation. Class participation is expected. Critical scientific reading and thinking is encouraged by having students present to the class published original research papers on topics of current interest in the field of developmental biology. II,(3,0)3

*Department of Biological Sciences***81.586 Biotechnology Processing Projects Laboratory**

Design and development of manufacturing processes for the products of biotechnology, with emphasis on techniques for the cultivation of cells, recovery and purification of cell products and analytical methods for the quantification of product yields. Prerequisite: Senior status in biology, chemistry, chemical engineering and permission of instructor (1,3)3

81.593 Immunology

A study dealing with the nature of the immune response with sections on antibody structure, function and production; antigen-antibody reactions; immunogenetics; and immune regulation, protection and injury. I(3,0)3

81.595 Immunology Laboratory

A series of basic laboratory exercises dealing with the preparation, isolation and characterization of antigens, antibodies and effector cells. Semester project required. I(1,4)2

Interdisciplinary Biology (Course Prefix: 82)

Courses of an interdisciplinary nature exploring areas resulting from the interaction of biological science with other fields - academic, professional, or practical. These courses cannot be used as 81 electives in the biology program.

82.202 Heredity and Society

Lectures and readings dealing with the genetic aspects of social problems emphasize that the borderline between genetics and medicine, ethics, politics, sociology, psychology, and agriculture are fertile areas for the development of new concepts. Successful completion of the course enables the student to offer informed opinions each time the genetic basis of social predicaments is introduced into the arena of public affairs and to correct many misconceptions in the public mind. (3,0)3

Life Science Courses (Prefix: 83)

Courses designed primarily to serve the needs of students who are not majoring or minoring in Biological Science. Although these courses may not ordinarily be used for degree credit for students majoring in Biological Sciences, they may be used as electives for others and may be used to satisfy University core requirements.

83.101 Life Science I

An examination of living systems from DNA to the biosphere. Emphasis is on cell structure and function, genetics, ecology and evolution. Corequisite: 83.103 I,II(3,0)3

83.102 Life Science II

Emphasis in this course is on human systems physiology. Topics include: nutrition and digestion, circulation, respiration, excretion, and nervous system functions. Also considered are the chemical interactions of these systems with immunity, hormonal and reproductive processes. Corequisite: 83.103 I,II(3,0)3

83.103 Life Science I Laboratory

Concerned with experimentation and interpretation of some of the concepts of Life Science I. Corequisite: 83.101 I,II(0,2)1

83.104 Life Science II Laboratory

Involved with experimentation and interpretation of some of the concepts of Life Science II. Corequisite: 83.102 I,II(0,2)1

83.123 Nutrition and Disease

An interdisciplinary, survey course for students not majoring in Biology which deals with human nutrition as it relates to various chronic disease states. Methods of detection and treatment of the disorders will be considered as well as general concepts of health promotion/disease prevention. Specific topics covered include the role of nutrition in: heart disease, diabetes, alcoholism, obesity, senility-geriatrics, gallbladder disease, cancer, anorexia nervosa-bulimia, and pregnancy. Parenteral nutrition will also be discussed. (3,0)3

Department of Chemistry

Stanley Israel, Chairperson

Eugene Barry, Graduate Coordinator

Philip Lamprey, Undergraduate Coordinator

Professors: William Bannister (Emeritus), Eugene Barry, Alexandre Blumstein (Emeritus), Rita Blumstein (Emerita) Rudolph Faust, Richard Gross, Stanley Israel, Edwin Jahngen, Ernest James (Emeritus), Judith Kelley, Albert Kowalak, Philip Lamprey, Kenneth Marx, Melisenda McDonald, James Pierce (Emeritus), Harry Rubinstein (Emeritus), Daniel Sandman, Joseph Salamone (Emeritus), Samuel Sawan, Ruth Tanner, Sukant Tripathy, Arthur Watterson

Associate Professors: Nancy DeLuca, Don Hilton (Emeritus), Martin Isaks, Kuang-Pang Li, Irving Lipschitz, David Ryan

Chemistry Major

Undergraduate offerings of the Chemistry Department solidly prepare students for continuing work in chemistry, as well as provide students a general background in the understanding of the natures of materials both natural and man made that are common to the modern world. Career opportunities in chemistry are many and varied, including, for example, applied and basic research, quality control, product analysis, manufacturing, and marketing. The B.S. degree in Chemistry is both a professional and a pre-graduate school degree. Completion of the chemistry curriculum provides a preparation for all areas of the chemical profession, as well as for graduate study in chemistry, dentistry, medicine, patent law, and teaching. Students completing the B.S. requirements graduate with a degree certified as being in a program approved by the Committee on Professional Training of the American Chemical Society.

Cooperative Education Program

The Chemistry Department has established guidelines for a cooperative program designed to combine chemistry oriented work experience in industrial or related laboratories with opportunities to

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earn an income. A student may enter this program after completing four semesters of academic work which must include the successful completion of one year of organic chemistry. Up to six academic credits will be allowed for the program which will include one summer and two academic terms of co-op work. A student applies for the program by signing a contract outlining the proposed co-op experience and requirements.

Financial Support and Awards

The Chemistry Department has a number of scholarships available. The Allen Scattergood Scholarships are awarded for superior academic achievement, requiring a minimum academic cumulative average of 3.500. Other scholarships are available based on financial need and academic record. Information regarding these can be obtained at the chemistry office or from the faculty member serving as Chairperson of the Scholarship and Awards Committee. The Department also has a number of annual awards for academic achievement, determined by the faculty and announced each spring.

Degree Requirements**I. University Core Requirements (21 credits)**

42.101	College Writing I	3 cr
42.102	College Writing II	3 cr
	Aesthetics	3 cr
	Behavioral and Social Sci	6 cr
	Historical Studies	3 cr
	Literature	3 cr

II. Major Field Requirements

A.	Chemistry	56-57 cr
84.121	Chem I	3 cr
84.123	Chem I Lab	1 cr
84.122	Chem II	3 cr
84.124	Chem II Lab	1 cr
84.207	Inorganic Chem	3 cr
84.209	Inorganic Chem Lab	2 cr
84.221	Organic Chem I	3 cr
84.227	Organic Chem Lab I	2 cr
84.222	Organic Chem II	3 cr
84.228	Org Chem Lab II	2 cr
84.260	Info Retrieval	1 cr
84.313	Analytical Chem I	3 cr
84.315	Analytical Chem I Lab	2 cr
84.314	Analytical Chem II	3 cr
84.316	Analytical Chem II Lab	2 cr
84.334	Inorganic Chemistry II	3 cr
84.344	Physical Chem I	3 cr

84.345	Physical Chem II	3 cr
84.346	Physical Chem I Lab	2 cr
84.350	Phys Bioinorganic Chem Lab	2 cr
84.360	The Responsible Chemist*	3 cr

*satisfies core requirement in Values, Concepts and Choice

Chem Elective with Lab**	3 or 4 cr
Chem Elective**	3 cr

**Chem electives must be advanced courses with basic course prerequisites including Physical Chem I and II

B. Supporting Science & Math 26 cr

95.101	Principles of Physics I	3 cr
96.103	Gen Exp Physics I	1 cr
95.202	Principles of Physics II	3 cr
96.104	Gen Exp Physics II	1 cr
92.111	Everyday Computing	3 cr
92.131	Calculus I or	4 cr
92.127	Calculus IA and	4 cr
92.128	Calculus IB	4 cr
92.132	Calculus II	4 cr
92.231	Calculus III	4 cr
92.234	Differential Equations	3 cr

Note: Only 4 of the 8 credits for Calculus IA and Calculus IB can be counted toward the total credits needed for graduation.

C. Foreign Language

Chemistry majors are required to take two semesters of or earn six credit hours for a foreign language at the introductory or intermediate level, or one semester (three credit hours) of a foreign language at an advanced level.

III. Program Options and Electives

Since the Bachelor of Science degree is meant to provide a broad educational experience as well as specialized training in chemistry, a minimum of 50 credits must be taken outside of chemistry. This requirement is met through the core, the physics, mathematics, and computer requirements, and electives.

Chemistry students, in consultation with their advisors, are encouraged to consider not only advanced courses in chemistry, but also courses and minors which develop their knowledge and abilities in other sciences, mathematics, engineering, and management.

The total minimum credit requirements for a B.S. degree in chemistry is 120 credit hours.

Chemistry Minor

A minor in chemistry consists of 18-24 credits in chemistry, exclusive of any coursework taken to satisfy the Area III requirements. All course prerequisites must be satisfied. The course requirements for the chemistry minor are as follows:

- a freshman level course (84.121, 84.123, and 84.122, 84.124) or the equivalent must be included;
- four additional courses of which not more than two may be from the same chemistry area;
- at least two courses must carry a laboratory component exclusive of 84.121, 84.123 and 84.122, 84.124;
- a lecture course with a corequisite laboratory course will be considered as one course of the additional course requirements; and
- at least eight semester hours must be taken at or above the 300 course level, and of these courses, at least three credits must be in a course not required by the curriculum of the student's department.

Sample Course of Study**Freshman Year****Fall Semester**

84.121	Chemistry I	3
84.123	Chemistry I Lab	1
42.101	College Writing I (Gen Ed)	3
92.131	Calculus I (or Calc IA)	4
91.111	Everyday Computing	3
	Beh & Soc St (Gen Ed)	3
		17

Note: In the event that 91.111 is not given in the fall semester it must be taken in the spring semester of the freshman year.

Spring Semester

84.122	Chemistry II	3
84.124	Chemistry II Lab	1
84.207	Descriptive Inorganic Chem	3
42.102	College Writing II (Gen Ed)	3
92.132	Calculus II (or Calculus IB)	4
		14

Sophomore Year**Fall Semester**

84.221	Organic Chemistry I	3
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84.227	Organic Chemistry I Lab	2
84.209	Inorganic Lab	2
95.201	Principles of Physics I	3
96.103	Exp Gen Physics I	1
92.231	Calculus III	4

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Spring Semester

84.222	Organic Chemistry II	3
84.228	Organic Chemistry II Lab	2
84.260	Information Retrieval	1
95.202	Principles of Physics II	3
96.104	Exp Gen Physics II	1
92.234	Differential Equations	3
	Beh & Soc St (Gen Ed)	3

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Junior Year**Fall Semester**

84.344	Physical Chemistry I	3
84.346	Physical Chemistry I Lab	2
84.313	Analytical Chemistry I	3
84.315	Analytical Chemistry I Lab	2
	Foreign Language	3
	History (Gen Ed)	3

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Spring Semester

84.345	Physical Chemistry II	3
84.350	Physical Bio Inorg Lab	2
84.314	Analytical Chemistry II	3
89.316	Analytical Chem Lab II	2
	Foreign Language	3
	Aesthetics (Gen Ed)	3

16

Senior Year**Fall Semester**

84.334	Inorganic Chemistry II	3
	Chem Elective with Lab*	3/4
	Literature (Gen Ed)	3
	Free Electives	6

15/16

Spring Semester

84.360	The Responsible Chemist	3
	(Satisfies Gen Ed, Values, C & C)	
	Chemistry Elective*	3
	Free Electives	6

12

Total Credits Required: 120

*The senior chemistry electives must be advanced courses which assume or require the basic chemistry courses of the first three years as prerequisites. Senior thesis,

84.407 and 84.408 can count for only one of the two required chemistry electives.

**Chemistry Courses
(Prefix: 84)****84.101 Applied Chemistry for Non-Scientists**

Provides an understanding of basic chemical principles—atomic structure, bonding and interparticle forces, physical and chemical properties of matter through hands-on examination of matter and the application of principles to understanding the chemistry of current issues (e.g., environmental chemistry, biochemistry, food and drug chemistry) and the analysis of problems dealing with these issues. I,II(3,0)3

84.111 General Chemistry I

A one semester survey of inorganic chemistry: the structure and properties of matter, chemical reactions, stoichiometry, gas laws, solution chemistry, kinetics, equilibrium, and acid-base chemistry. Corequisite: 84.113 I(3,0)3

84.112 General Chemistry II

A survey of the basic principles of organic chemistry and biochemical aspects of carbohydrates, lipids, proteins and nucleic acids. Prerequisite: 84.111 or permission of instructor. Corequisite: 84.114 II(3,0)3

84.113 General Chemistry Laboratory I

Laboratory experiments designed to illustrate the principles covered in 84.111. Corequisite: 84.111 I(0,3)1

84.114 General Chemistry Lab II

Laboratory experiments designed to illustrate the principles discussed in 84.112. Prerequisite: 84.113 or permission of instructor. Corequisite: 84.112 II(0,3)1

84.121 Chemistry I

Introduction to basic concepts of chemistry. Topics include chemical calculations, atomic structures, the periodic table, basic bonding theory, solutions, liquids, and gases. Corequisite: 84.123 I(4,0)3

84.122 Chemistry II

A continuation of 84.121. Topics include thermodynamics, kinetics, acids and bases, introduction to organic chemistry, chemical equilibrium, precipitation reactions, and electrochemistry. Prerequisite: 84.121. Corequisite: 84.124 II(4,0)3

84.123 Chemistry I Lab

Experimental study of chemical principles and chemical transformation coordinated with topics considered in 84.121. Examines some of the more important reactions of elements, oxides, acids, bases, and salts. Other topics include chemical separation, purification, preparation of inorganic salts, quantitative determinations dealing with the formula of a compound, gas laws, and colligative properties. Stresses careful techniques and precise measurements. Corequisite: 84.121 I(0,3)1

84.124 Chemistry II Lab

A continuation of the laboratory study begun in 84.123 that is coordinated with topics of 84.122. Topics include: thermochemistry, kinetics, spectroscopy, titration, pH, equilibrium reaction and constants. Some aqueous solution reactions and organic reactions are examined. Accurate measurements and precise instrumental and apparatus operation are expected. Corequisite: 84.122 II(0,3)1

84.135 Honors Chemistry I

A more in-depth view of the topics covered in Chemistry I, (84.121). Topics include chemical reactions and calculations, atomic history and structures, the behavior of gases and bonding theory. Open to students enrolled in the Honors Program, and may be taken instead of 84.121. Corequisite: 84.123 I(3,0)3

84.136 Honors Chemistry II

A continuation of 84.135. A more in-depth view of the topics covered in Chemistry II (84.122). Topics include solutions, kinetics, thermodynamics, acids and bases, chemical equilibrium, electrochemistry and solubility. Open to students enrolled in the Honors Program, and may be taken instead of 84.122. Prerequisite: 84.121 or 84.135. Corequisite: 84.124 II(3,0)3

84.203 Principles of Organic Chemistry

A one semester survey of the essential concepts, compounds, and reactions of organic chemistry. Open only to Plastics Engineering majors. Corequisite: 84.205 I(3,0)3

84.205 Principles of Organic Chemistry Laboratory

Introduction to the basic skills and techniques used in the synthesis, purification,

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and characterization of representative organic compounds. Open to Plastics Engineering students in the fall semester and Chemical Engineering students in the spring semester. Corequisite: for Plastics majors—84.203, for Chemical Engineers—84.222 I,II(0,4)1

84.207 Descriptive Inorganic Chemistry

The chemical behavior, structure and methods of preparation and nomenclature of the more common elements and their compounds. Corequisites: 84.122, 84.124 II(3,0)3

84.209 Inorganic Chemistry Laboratory

Laboratory to study the reactions of ions in aqueous solutions and to carry out inorganic syntheses and characterizations. Prerequisite: 84.207 I(0,4)2

84.221 Organic Chemistry I

Basic principles and reactions which characterize the chemical behavior of carbon compounds. Covers nomenclature, reactions, reaction mechanisms, and stereochemistry. Required for chemistry majors. Prerequisites: 84.122 and 84.124 Corequisite: 84.227 or 84.229 I(4,0)3

84.222 Organic Chemistry II

A continuation of 84.221 including an introduction to infrared and NMR spectroscopy and biochemistry. The application of organic reactions in multi-step synthesis is stressed. Required for chemistry majors. Prerequisite: 84.221 Corequisite: 84.228 or 84.230 II(4,0)3

84.227 Organic Chemistry Lab I

Laboratory work designed to emphasize the techniques of organic synthesis and the use of instrumentation for identification and characterization of organic compounds. Required for chemistry majors. Prerequisite: 84.124 Corequisite: 84.221 I(0,4)2

84.228 Organic Chemistry Lab II

A continuation of 84.227 including an introduction to semimicro organic techniques. Planning and successfully carrying out reactions published in the chemical literature are emphasized. Required for chemistry majors. Prerequisites: 84.221 and 84.227 Corequisites: 84.222 and 84.260 II(0,4)2

84.229 Organic Chemistry Lab IA

Techniques, skills and heuristic approaches in the synthesis, purification, and identification of organic compounds. IR, GC, and NMR instrumental methods are included. Corequisite: 84.221 I(0,4)1

84.230 Organic Chemistry Lab IIA

A continuation of 84.229. Prerequisite: 84.229 Corequisite: 84.222 II(0,4)1

84.260 Information Retrieval

An introduction to the important chemical and chemical-related reference sources including journals, patents, technical publications, and compiled reference works, and instructions in their use. Assignments require the use of each source discussed. On-line searching using computerized chemical and chemical related databases is also introduced. Corequisite: 84.228 II(1,0)1

84.300 Directed Studies in Chemistry I

An introduction to techniques of research. Open only to chemistry majors. Credit does not count toward those for A.C.S. certification nor toward the total of 126 credits for graduation. Prerequisites: four semesters of college level chemistry with laboratory and permission of instructor II(0,3-6)1

84.313 Analytical Chemistry I

Focuses on the evaluation of analytical data, aqueous and non-aqueous acid-base systems, oxidation reduction and complexation equilibria, solubility and precipitation, solvent extraction, ion-exchange and chromatographic methods. Corequisite: 84.315 I(3,0)3

84.314 Analytical Chemistry II

Introduces the student to modern instrumental methods of chemical analysis. Included are such topics as ultraviolet-visible, emission and atomic absorption spectroscopy. The principles and applications associated with mass spectrometry, thermal and electrochemical methods of analysis, chromatographic techniques such as GC and HPLC are also presented. This course is required for chemistry majors and is strongly recommended for students in the M.S. and Ph.D. programs in Environmental Studies with permission of the instructor. Prerequisites: 84.313 and 95.202 Corequisite: 84.316, 84.345 II(3,0)3

84.315 Analytical Chemistry I Lab

Experiments emphasizing the topics presented in 84.313 are conducted. Corequisite: 84.313 I(0,4)2

84.316 Analytical Chemistry II Lab

Laboratory experiments are designed to complement the coverage of topics in 84.314. Prerequisites: 84.313, 84.315 Corequisite: 84.314 II(0,4)2

84.321 Advanced Organic Laboratory

Involves more advanced laboratory work in organic chemistry using modern techniques of synthesis. Instrumentation and chemical methods are used to identify reaction products as well as unknown compounds. Prerequisite: 84.222 I(1,6)3

84.324 Principles of Analytical Chemistry

Designed to introduce engineering and science (other than chemistry) majors to the theory of gravimetric, volumetric, spectroscopic, and chromatographic analysis. Not open to students who have taken 84.314, 84.316, 84.313, or 84.315. Prerequisites: 84.122 and 92.131 or 92.125 Corequisite: 84.325 I or II(3,0)3

84.325 Principles of Analytical Chemistry Lab

Designed to parallel the lecture topics in 84.324 with a particular emphasis on practical and applied conventional analytical analysis such as gravimetric, titrimetric, and spectroscopic analysis. Prerequisite: 84.124 or equivalent Corequisite: 84.324 I or II(0,4)1

84.334 Advanced Inorganic Chemistry

An introduction to modern theories of atomic structure and chemical bonding, with emphasis on physical/chemical principles and properties. Considerable time is spent on coordination compounds including topics such as descriptive chemistry, biochemical importance, and ligand field theory. Prerequisite: 84.345 II(3,0)3

84.339 Physical Chemical Principles

A one semester course designed for plastics engineering majors. Physical chemical concepts of importance to plastics and polymeric materials are emphasized and include kinetics, spectroscopy, phase rule, and statistical thermodynamics. Prerequisites: 84.122, 26.247 Corequisite: 84.341 I or II(2,0)2

Department of Chemistry

84.341 Physical Chemical Principles Lab

Laboratory work designed to exemplify principles and applications covered in 84.339. Corequisite: 84.339 I or II(0,3)1

84.344 Physical Chemistry I

The 84.344/345 sequence covers basic physical chemical topics: laws of thermodynamics, solutions, chemical and phase equilibria, electrochemistry, kinetics, and atomic and molecular structure. Required for chemistry majors. Prerequisite: 92.231 I or II(3,0)3

84.345 Physical Chemistry II

A continuation of 84.344. Required for chemistry majors. Prerequisite: 84.344 I or II(3,0)3

84.346 Physical Chemistry Lab I

Laboratory work designed to exemplify principles covered in 84.344. Required for chemistry majors. Prerequisite: 84.124 Corequisite: 84.344 I or II(0,3)1

84.347 Physical Chemistry Lab II

Laboratory work designed to exemplify principles of chemical kinetics, equilibrium and spectroscopy. Corequisite: 84.345 I or II(0,3)1

84.350 Physical Bioinorganic Chemistry Lab

Coordination compounds are utilized in a core of experiments to illustrate basic physiochemical techniques and analysis of experimental data in electrochemistry and kinetics. A project lab is carried out to apply and extend techniques learned. Prerequisites: 84.344 and 84.346 or other laboratory experience in thermodynamics Corequisite: 84.345 I(1,3)2

84.360 The Responsible Chemist

Covers topics of importance to chemists involving ethics and values. Following an in-depth consideration of the nature of ethics and values, topics such as chemical safety, the chemical profession, and industrial chemistry are discussed with particular focus on the ethical issues involved. II(3,0)3

84.403 Introductory Polymer Science I

Coverage of step and chain growth polymerizations, kinetics and mechanism, copolymerization, ionic and free radical polymerizations, and industrially important polymers. Prerequisite: 84.222 or 84.203, 84.339 or 84.345 I(3,0)3

84.404 Introductory Polymer Science II

An introduction to the physical chemistry of polymers including molecular weight distribution and averages, polymer solutions, fractionation, methods of molecular determination, and structure. Prerequisites: 84.203 or 84.222, 84.339 or 84.345 II(3,0)3

84.405 Polymer Laboratory I

An introductory laboratory in polymer science concerned with the physical and chemical characterization of polymers. Prerequisites: 84.203 or 84.222, 84.345 or 84.339 Corequisite: 84.403 II(0,4)1

84.406 Polymer Laboratory II

An introductory laboratory in polymer science concerned with the techniques of polymer synthesis. Prerequisites: 84.203 or 84.222, 84.345 or 84.339 Corequisite: 84.404 II(0,4)1

Theses

Credit for 84.407/408 Undergraduate Thesis in Chemistry I and II may be used by chemistry majors for credit and as a chemistry elective only when the thesis is under the direction and direct supervision of a member of the chemistry faculty. Interdisciplinary research may be used for chemistry credit only when the thesis is under direct supervision of a member of the chemistry faculty, with the second department involved in an advisory role or supportive role. When those roles are reversed, or when research is done principally or totally under the direction of a faculty member of another department, the undergraduate research must be taken under the auspices of the other department involved using the corresponding undergraduate research course numbers for that department. The course may then be used as a general elective in the chemistry major program. However, only six credits in any undergraduate research experience will be applied to an academic program in chemistry for the minimum graduation credit. In the case of interdisciplinary research, when one semester is done in another department, a total of six credits for the year may be counted toward graduation with the stipulation that the second semester of research is a continuation of the first semester. In this special case, the student would earn three chemistry credits and three elective credits for undergraduate research.

84.407 Undergraduate Thesis I

Research in biochemistry, electrochemistry or analytical, organic, inorganic, physical or polymer chemistry. Progress report required. Prerequisite: permission of department chairperson and thesis supervisor. For credit for ACS certification, 84.407 must be followed by 84.408 I(0,9-12)3

84.408 Undergraduate Thesis II

A continuation of 84.407. Both semesters must be taken and not more than six credits may be used in meeting degree requirements. A written thesis and seminar are required. The written thesis is to follow the conventional form of introduction, literature survey, data, results, and conclusions. One copy of the thesis must be filed in the Department office. Prerequisite: permission of the department chairperson and thesis supervisor II(0,9-12)3

84.419 Introductory Biochemistry

An introductory study of the fundamental principles of biochemistry including the chemistry of proteins, carbohydrates, nucleic acids and lipids, thermodynamics, kinetics and mechanisms of enzyme action, intermediary metabolism and selected topics in molecular biology. Prerequisites: 84.222, 84.344, or permission of instructor I(3,0)3

84.420 Introductory Biochemistry Lab

Laboratory experiments designed to acquaint the students with modern techniques in biochemistry and to emphasize material covered in 84.330. Prerequisite or corequisite: 84.419 or permission of instructor II(0,6)2

84.423 Advanced Organic Chemistry I

Extension of introductory organic chemistry. Organic reactions and compounds are discussed in terms of reaction mechanisms, structure-reactivity and stereochemistry. Prerequisite: 84.222 I(3,0)3

84.424 Advanced Organic Chemistry II

Synthesis of organic molecules. Selected reagents and techniques are discussed with emphasis on the scope and limitations of these reactions. The reaction mechanisms are also discussed. Prerequisite: 84.423 or permission of instructor II(3,0)3

84.425 Industrial Organic Chemistry

An advanced organic chemistry course

dealing with the synthesis of large volume organic materials and their industrial and consumer uses. An area of particular focus is the manufacture of pharmaceuticals ranging from over-the-counter drugs to ethical drugs. Prerequisites: 84.222, 84.339 or 84.344 I(3,0)3

Primarily for Graduate Students

All graduate courses are open to undergraduate students with the permission of the instructor.

84.510 Electron Microscopy of Advanced Materials

Introduces the principles and practical applications of electron microscopy analytical methods for ceramics, electronic materials, polymers and biological materials. Includes theories of instruments and hands on laboratory experience in their use. Prerequisite: permission of instructor II(3,0)3

84.513 Spectroscopy

A theoretical and practical interpretation of molecular spectra and an introduction to lasers and their applications to spectroscopy. II(3,0)3

84.514 Advanced Analytical Chemistry

Designed to provide graduate students and senior undergraduate students with an understanding of the principles and the theory of analytical measurements and instrumentation. The course is divided into three sections consisting of a) analytical measurements including potentiometry and voltammetry, b) spectrophotometric measurements (i.e. molecular spectrometry), and c) ionic equilibria and statistics. This course is required for graduate programs in Analytical Chemistry and Environmental Studies (Ph.D.) and is recommended for students in other graduate programs such as Biology, Biochemistry and Environmental Studies (M.S.) and other areas of chemistry. Prerequisite: permission of instructor I(3,0)3

84.515 Chemical Literature

Use of the chemical library, journals, reference works, patents and other technical publications pertaining to chemical subjects. Exercises are given in finding, assembling, and using data found in the

literature. The student is also expected to assimilate the use of automated information retrieval and conduct computer assisted literature searches. Prerequisite: permission of instructor I(2,2)3

84.516 Advanced Laboratory Technique

A study of the theory and application of more advanced techniques and equipment in the preparation and purification of organic and inorganic compounds including high efficiency vacuum distillation and hydrogenation reactions in inert atmospheres. The student masters analytical techniques which involve the "hands-on" use of I.R., NMR, GLC, TLC and other instrumental methods of product identification. Prerequisites: 84.523 and permission of instructor II(1,6)3

84.517 Glass Working

Fundamental techniques in the preparation and assembling of glass apparatus. The student practices the art and science of scientific glass blowing. Skill in the assembly of simple scientific glass apparatus is stressed. Open to all students. Prerequisite: permission of instructor II(2,3)3

84.519 Environmental Chemistry III (Marine Chemistry)

Covers chemical processes and measurements in marine and estuarine systems. Emphasis is placed on water column processes; however, air-water and sediment-water interface phenomena are covered as well. Topics include but are not limited to: ionic equilibria, trace metal complexation, redox processes, mathematical modeling applied to chemical systems, and oceanographic sampling. Prerequisite: permission of instructor I(3,0)3

84.521 Physical Organic Chemistry

Quantitative aspects of the study of organic reaction mechanisms. Kinetic methods, linear free energy relationships, orbital symmetry effects, and other selected topics are covered. Prerequisites: 84.423, 84.523 or equivalent I(3,0)3

84.523 Organic Reaction Mechanisms and Structures

Provides insight into how reactions occur and how reaction mechanisms are studied. Emphasis is placed on bonding, structure and reactivity. Conformational analysis and stereoelectronic effects, including an introduction to the application of compu-

tational chemistry to these subjects. I(3,0)3

84.524 Organic Synthesis

Mechanism, scope and limitations of important selected types of reactions and design of synthetic sequences. Emphasis is placed on methodology of synthesis and current literature. Prerequisite: 84.523 or permission of instructor III(3,0)3

84.525 Analysis of Advanced Materials

Introduces the principles and practical applications of scanning probe microscopy and X-ray diffraction methods for ceramics, electronic materials, polymers, and biological materials. Hands-on laboratory sessions provide details of the operation of the instrumentation involved. Prerequisite: permission of instructor I(3,0)3

84.526 Theory and Applications of Chromatography

Coverage directed to the performance of packed and capillary column for gas chromatography and HPLC. Modern injection, detector and pumping systems used in chromatography are also discussed. Prerequisite: permission of instructor I or II(3,0)3

84.527 Stereochemistry

The fundamental concepts of symmetry and optical activity. The relationship of stereostructures to the physical and chemical properties of organic compounds. Offered in alternate years. Prerequisites: 84.523 and 84.524 or equivalent I(3,0)3

84.528 Electroanalytical Chemistry

Intent is to present an introduction to the theory and application of modern electroanalytical chemistry. The course is divided into a discussion of electrode processes, electroanalytical techniques, and the instrumentation required to make electrochemical measurements. Modern polarography, stationary electrode voltammetry, chronoamperometry, bulk electrolysis, chronopotentiometry and hydrodynamic electrochemistry are among the topics considered. A detailed discussion of the design and operation of electrochemical detectors is presented. Prerequisite: 84.314 or permission of instructor I or II(3,0)3

*Department of Chemistry***84.531 Statistical Thermodynamics**

Fundamentals of equilibrium statistical mechanics, classical and quantum statistics. Molecular theories of gases, crystals, and liquids with emphasis on chemical aspects. Electrolyte and non-electrolyte solutions, polymer and polyelectrolyte systems, chemical equilibria and reaction rate processes. Also, an introduction to non-equilibrium statistical theories.

Prerequisite: 84.532 or equivalent I(3,0)3

84.532 Advanced Physical Chemistry

Extension of introductory physical chemistry. Open to seniors and first year graduate students in chemistry and related fields. Emphasis is placed on quantum chemistry of atoms and molecules as well as on classical and statistical thermodynamics. Prerequisite: permission of instructor II(3,0)3

84.534 Quantum Chemistry

Principles and methods of quantum mechanics with special attention to chemical applications such as electronic structure of atoms and molecules, vibrations and rotation of molecules, and interaction of radiation and matter. Prerequisite: 84.532 or equivalent I or II(3,0)3

84.535 Advanced Topics in Physical Chemistry

Selected topics and recent advances in physical chemistry. Selection of topics is at the discretion of the instructor. Prerequisite: permission of instructor I(3,0)3

84.536 Advanced Topics in Physical Chemistry

Same as 84.535 with different topics. Prerequisite: permission of instructor II(3,0)3

84.538 Biochemical Mechanisms

Discussion of various biochemical reactions from the point of view of organic reaction mechanisms. Kinetics, coenzymes and methods of the study of enzyme and catalysis and mechanisms is emphasized. Prerequisite: 84.551 or permission of instructor II(3,0)

84.540 Chemical Kinetics

The theoretical and empirical treatment of chemical kinetics data as well as the methods of obtaining these data. Determination of the order of reactions, factors influencing rates, application of rate studies in establishing hypotheses for reaction mechanisms,

collision theory and absolute rate theory. Prerequisite: 84.345 or equivalent II(3,0)3

84.543 Modern Inorganic Chemistry

A theoretical treatment of atomic structure and chemical bonds, included are such topics as Russell Saunders' coupling, molecular orbital theory, ligand field theory, and descriptive coordination chemistry. Prerequisite: one year of physical chemistry. I(3,0)3

84.544 Chemical Application of Group Theory

Classification of molecules into point groups. Properties of groups as applied to chemical systems. Development of the ligand field theory and prediction of electronic and vibration-rotational spectra. Prerequisite: 84.334 or 84.534 or equivalent II(3,0)3

84.545 Advanced Physical Chemistry for Environmental Studies

Coverage of the key areas of physical chemistry with emphasis on the topics with applications in environmental chemistry. For environmental science graduate students only. I or II(3,0)3

84.546 Organic Chemistry for Environmental Studies

A review of fundamental organic chemistry with emphasis on aspects with particular relevance to environmental chemistry. For environmental science graduate students only. I or II(3,0)1

84.550 Biochemistry I

An advanced study of the structure and properties of proteins, nucleic acids, carbohydrates and lipids including kinetics and mechanisms of enzyme action and detailed description of metabolic pathways of carbohydrates and lipids. Prerequisites: 84.222 and 84.339 or 84.344 or permission of instructor I(3,0)3

84.551 Biochemistry II

A continuation of 84.550 with emphasis on metabolic pathways of amino acids and nucleic acid, biosynthesis of proteins and selected topics in molecular biology and various areas of biochemistry. Prerequisite: 84.550 or permission of instructor II(3,0)3

84.556 Electronics and Instrumentation for Science

Covers the theory and applications of electronics in modern chemical instrumentation II(2,3)4

84.560 Advanced Physical Biochemistry

Physical chemistry encompasses a group of principles and methods helpful in solving many different types of problems. This course will present selected principles of thermodynamics, kinetics, statistical thermodynamics and quantum mechanics as they are applied to biochemical systems. Various experimental techniques will be strongly emphasized in view of their importance in biochemical research. Prerequisite: 84.345, 84.550 or permission of instructor I(3,0)3

84.563 Chemistry of Natural Products

Covers the proof of structure of various types of natural products, approaches to the total synthesis of these products and the biosynthetic pathways. Prerequisite: 84.524 or 84.568 or equivalent I(3,0)3

84.565 Heterocyclic Chemistry

Classification, nomenclature, structure, synthesis, and utility of the more important classes of heterocyclic compounds. Offered in alternate years. Prerequisite: 84.524 or equivalent I(3,0)3

84.568 Structural Analysis

Practical applications of instrumental data in the determination of the structure of organic compounds and polymers. Includes mass spectrometry, ultra-violet spectroscopy, infrared spectroscopy and nuclear magnetic resonance spectroscopy. Open to undergraduate students with permission. Prerequisite: 84.222 or equivalent II(3,0)3

84.580 Advanced Analytical Biochemistry

Analytical biochemistry involves the separation, detection, and analysis of biological molecules. This course addresses advanced theory and applications of contemporary biochemical techniques and instrumentation. Topics covered include chromatographic and electrophoretic separation techniques, detection of biomolecules by spectroscopy and radiochemical methods, biological preparations, and structural analysis of proteins, nucleic acids, polysaccharides and lipids. Prerequisite: 84.550 or permission of instructor II(3,0)3

COLLEGE OF ARTS AND SCIENCES*Department of Chemistry***84.585 Nuclear Chemistry**

Stresses the fundamentals of radioactivity, atomic nuclei, nuclear reactions, reactors and detection, and measurement of radiation. Application of material and anthropogenic radioactive tracers to oceanic and atmospheric studies is also presented. Prerequisite: permission of instructor I,II(3,0)3

**Polymer Chemistry Courses
(Prefix: 97)**

Courses in polymer chemistry are primarily for graduate students but are open to undergraduates with the permission of the instructor.

97.503 Advanced Polymer Science I

A study of the principles of condensation, free radical, ionic, coordination and ring opening polymerization. The topics include the effect of polymerization techniques on reaction kinetics and molecular weight, and the evaluation of reactivity ratios in copolymerization reactions. Prerequisite: permission of instructor I(3,0)3

97.504 Advanced Polymer Science II

Introduction to chain statistics and thermodynamics of macromolecular solutions, methods of study of molecular weight and chain conformation, and the properties of polymers in bulk including viscoelasticity and crystallinity. Prerequisite: permission of instructor II(3,0)3

97.505 Polymer Preparation and Characterization

An advanced laboratory in polymer science concerned with the synthesis and characterization of macromolecules. Prerequisite: permission of instructor I(0,4)1

97.511 Biopolymers

Topics include conformation and configuration of vinyl polymers and polypeptides, energetics of chain folding and examination of the forces dictating ordered structures, helix to coil transitions in biopolymers with emphasis on polypeptide structures, instrumental analysis of biopolymer conformation, synthesis of biopolymers including polypeptides, polysaccharides and polynucleotides, and examination of relationships between synthetic polymers and naturally occurring polymers. Prerequisite: permission of instructor I(3,0)3

97.512 Properties of Bulk Polymers

Structure and properties of bulk polymers in the glassy, rubber and crystalline states. Topics include chain statistics, rubber elasticity, crystalline polymers, glass transition, segmental motion and viscoelasticity. Prerequisite: permission of instructor II(3,0)3

97.549 Physical Chemistry of Macromolecules

Physical chemistry of polymer including structure and conformation, chain statistics, molecular weight distributions and averages, polymerization kinetics and classical and statistical thermodynamics of polymer systems including polyelectrolytes. Prerequisite: 97.503 or equivalent I(3,0)3

97.550 Physical Chemistry of Macromolecules II

Optical and hydrodynamic properties of polymer solutions. Methods of determination of structural parameters, including light scattering, viscometry, and other techniques. Prerequisite: 97.503 or equivalent II(3,0)3

97.553 Organic Chemistry of Macromolecules

An advanced study in polymer science concerned with the synthesis of macromolecules and their mechanisms of formation. Prerequisites: 97.503, 97.504 I(3,0)3

97.651 Selected Topics in Polymer Science

Advanced topics in various aspects of polymer science. Content may vary from year to year so that students may, by repeated enrollment, acquire a broad knowledge in the field of macromolecules. Prerequisite: permission of instructor I or II (3,0)3

97.751 Advanced Projects in Polymer Science

Special projects undertaken by a student to expand knowledge in a specific field not necessarily related to the thesis. Content of project and hours assigned must be approved by the department chair. I or II (3,0)1

Department of Computer Science

James Canning, Chairperson

Undergraduate Coordinator: John Sieg

Professors: Thomas Costello, Georges Grinstein, Raymond Gumb, Patrick Krolak, Robert Lechner, Giampiero Pecelli, Stuart Smith

Associate Professors: John Buford, James Canning, Jesse Heines, Byung-Guk Kim, Haim Levkowitz, William Moloney, John Sieg, Charles Steele

Assistant Professor: Marian Williams

Graduate Coordinator: Stuart Smith

Computer science is the study of the design and use of computer systems. The goal of the computer science curriculum is to provide the student with the tools to identify those problems that are best solved by means of a computer and to design and implement effective, economical, and creative solutions.

The curriculum's required courses give the student a strong foundation in both the software and hardware aspects of computing, as well as the mathematics and science that underlie the discipline. The electives in the later years allow the student to study more deeply some particular area of computer science.

Graduates of the Department of Computer Science are well trained in systems software design and implementation and have found ready employment in local companies. The Department's courses and programs continue to respond to changing requirements for professional employment in computer science.

The Computer Science Major**Summary of Degree Requirements****I. General Education Requirements**

Students who enrolled in the Fall 1993 and later must satisfy the General Education requirements. Computer Science majors automatically satisfy the Mathematics and Sciences parts of the General Education requirements. The remaining requirements are as follows:

College Writing	6 cr
Literature	3 cr
Historical Studies	3 cr

Department of Computer Science

Aesthetics	3 cr
Behavioral and Social Studies	6 cr
Values, Concepts, and Choice	3 cr

II. Major Requirements**A. Computer Science courses**

91.101	Computing I & Lab	4 cr
91.102	Computing II	4 cr
91.201	Computing III	4 cr
91.203	Comp Org & Assem Lang	4 cr
91.204	Computing IV	3 cr
91.301	Org of Programming Lang	3 cr
91.304	Foundations Computer Sci	3 cr
91.305	Computer Architecture	3 cr
91.308	Intro to Operating Systems	3 cr
91.404	Analysis of Algorithms	3 cr
	C S Project Sequence	3-6 cr

All Computer Science majors must take a one- or two-semester project course from an approved department list. Students who take an approved one-semester project course such as Compiler Writing or Robotics I must take two Computer Science electives; otherwise, one is needed. Students may not elect more than a total of six credits from any combination of the following: 91.401, 91.402, 91.460, and 91.490.

Current project course sequences include

91.309	Database I
91.310	Database II
91.353	GUI Programming I
91.461	GUI Programming II
91.401	Software Project Lab I
91.402	Software Project Lab II
91.406	Introduction to Compiler Writing
91.413	Data Communications I
91.414	Data Communications II
91.420	Artificial Intelligence
91.421	Knowledge-Based Systems
91.427	Graphics I
91.428	Graphics II
91.450	Robotics I

Because this list is subject to continuous revision, students should check with their advisors for the latest information. Some project sequences are not offered every school year. Thus, you should take the second course of a project sequence the semester after you take the first course of that sequence.

Computer science electives appear under

the heading "Computer Science Electives" in the course listing. Most 500-level computer science courses can also be used as computer science electives. For example, undergraduates often are qualified to take 91.502, 91.515, 91.521, 91.222, 91.538, 91.539, 91.540, 91.541, 91.543, or 91.546.

B. Supporting Courses in Science and Mathematics

92.131	Calculus I	4 cr
92.132	Calculus II	4 cr
95.141	Physics I & Lab	4 cr
95.144	Physics II & Lab	4 cr
92.231	Calculus III	4 cr
92.321	Discrete Structures I	3 cr
92.322	Discrete Structures II	3 cr
92.386	Statistics for Sci/Eng	3 cr
16.267	Logic Design	3 cr

C. Additional Writing Requirement 3 cr

42.xxx A writing course beyond College Writing II. A list of approved courses is available in the Computer Science Department Office.

D. Quantitative Elective Courses 6 cr

Each student must take two three-credit courses in quantitative areas outside of Computer Science or Pure Mathematics. Courses in Applied Mathematics, Engineering, the Sciences and other areas of an advanced quantitative content satisfy this requirement. In the social sciences, courses that have calculus or mathematical statistics as prerequisites satisfy this requirement. A list of approved quantitative electives is available in the Computer Science Department Office.

E. Unrestricted General Elective Courses 12 cr

Students in the Class of 1998 and later must ordinarily take four three-credit general (or "free") electives. Courses from any academic department are acceptable as general electives, except that science, mathematics, and engineering courses, and courses with a computing component, must be at a level higher than that of courses required by the Computer Science program.

III. Academic Standing

Beginning with the first semester of the sophomore year, and every semester thereafter, each computer science major must maintain

1. a GPA of 2.5 or better in required computer science courses, project courses, and computer science electives

2. an overall GPA of 2.3

Students who fail to satisfy these requirements will have their records reviewed by the department's Undergraduate Committee and may be dropped from the computer science program.

BS/MS program

The Computer Science Department has a BS/MS degree program. Two advantages of the program are 1) the ability in some cases to count computer science courses for both your BS program and your MS program and 2) being accepted into the MS program without taking the Graduate Record Examination.

To be accepted in this program, you must have good grades and apply in your Junior year. There are many rules governing eligibility for the program. Applicable Graduate School rules appear in Graduate School Catalog.

There are advantages and disadvantages to getting your Masters degree at the same place you received your BS. If you are interested in the BS/MS program, please discuss it with your academic advisor or other faculty member.

The Computer Science Minor

The Computer Science minor is primarily intended for students in the sciences, engineering, or other field with a substantial quantitative component. The following courses are required for completion of the computer science minor:

91.101	Computing I & Lab	4
91.102	Computing II	4
91.201	Computing III	4
91.203	Comp Org & Assem Lang	4
91.	300/400 level course	3
91.	300/400 level course	3

In addition, either 92.321 (Discrete Structures I) or 92.211 (Linear Algebra) must be taken before any computer science course numbered 91.301 or higher.

COLLEGE OF ARTS AND SCIENCES

Department of Computer Science

Suggested Curriculum

For students entering program as freshmen in September 1994 and subsequently

Freshman Year**Fall Semester**

91.101	Computing I & Lab	4
92.131	Calculus I	4
95.141	Physics I & Lab	4
42.101	College Writing I	3

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Spring Semester

91.102	Computing II	4
92.132	Calculus II	4
95.144	Physics II & Lab	4
42.102	College Writing II	3

15

Sophomore Year**Fall Semester**

91.203	Comp Org & Assem Lang	4
91.201	Computing III	4
92.231	Calculus III or	
16.267	Logic Design	4/3
92.321	Discrete Structures I	3

15/14

Spring Semester

91.204	Computing IV	3
92.386	Statistics for Sci/Eng	3
92.322	Discrete Structures II	3
16.267	Logic Design or	
92.231	Calculus III	3/4
	Additional Writing Requirement	3

15/16

Junior Year**Fall Semester**

91.304	Foundations of Comp Sci*	3
91.305	Computer Architecture	3
	Quantitative Elective	3
	GER Course	3
	GER Course	3

15

Spring Semester

91.301	Organization of Prog Lang	3
91.308	Intro to Operating Syst	3
	Quantitative Elective	3
	GER Course	3
	GER Course	3

15

Senior Year**Fall Semester**

91.	Project Course (1)	3
91.404	Analysis of Algorithms	3
	GER Course	3
	General Elective	3
	General Elective	3

15

Spring Semester

91.	Project Course (2)	3
	CS Elective	3
	GER Course	3
	General Elective	3
	General Elective	3

15

*Students who entered before fall 1994 take a CS elective instead of 91.304.

Computer Science Courses (Prefix:91)**91.100 Computing I Laboratory 1 cr****91.101 Computing I**

Introduction to computing environments; introduction to an integrated development environment; the C language. Linear data structures; arrays, records, and linked lists. Abstract data types, stacks, and queues. Simple sorting via exchange, selection, and insertion. Basic file I/O. Programming style, documentation, and testing. Ethical and social issues. Corequisite: 91.100 3 cr

91.102 Computing II

Pointers. Lists, stacks, and queues. Binary trees, AVL trees, n-ary trees. Advanced sorting via quicksort, heapsort, etc. Sets and hashing. Characters and strings. Graphs. Advanced file techniques. Recursion. Programming style, documentation, and testing. Ethical and social issues. Prerequisite: 91.101 4 cr

91.201 Computing III

Object-oriented programming. Classes, methods, polymorphism, inheritance. Object-oriented design. C++. UNIX. Ethical and social issues. Prerequisite: 91.102 4 cr

91.203 Computer Organization and Assembly Language

The organization and operation of a conventional computer, including principal instruction types, data representation,

addressing modes, program control, and I/O. Assembly language programming, including instruction mnemonics, symbolic addresses, assembler directives, system calls, and macros. The usage of text editors, symbolic debuggers, and loaders. The use of pseudocode in guiding structured assembly language programming. Prerequisite: 91.101 4 cr

91.204 Computing IV

Construction of program-translation software, such as compilers, assemblers, and linkers. Software engineering principles and practice. Object-oriented analysis and design. UNIX and CASE productivity aids. Prerequisites: 91.201, 91.203 3 cr

91.301 Organization of Programming Languages

Analytical approach to the study of programming languages. Description of the salient features of the imperative, functional, logical, and object-oriented programming paradigms in a suitable metalanguage such as Scheme. Topics include iteration, recursion, higher-order functions, types, inheritance, unification, message passing, orders of evaluation, and scope rules. Elementary syntactic and semantic descriptions. Implementation of simple interpreters. Prerequisites: 91.204 3 cr

91.304 Foundations of Computer Science

A survey of the mathematical foundations of Computer Science. Finite automata and regular languages. Stack Acceptors and Context-Free Languages. Turing Machines, recursive and recursively enumerable sets. Decidability. This course involves no computer programming. Prerequisite: 92.322 3 cr

91.305 Computer Architecture

An examination of the basic functional components of a computer system including the CPU, memory systems, and I/O systems. Each of these three areas will be developed in detail with a focus on the system design and component integration. Topics will include CPU control and ALU operation, computer timing, data address and I/O bus activity, addressing model, programmed and DMA I/O, and instruction sets and microcode. Prerequisites: 91.203, 16.267, 91.102 3 cr

91.308 Introduction to Operating Systems

An introduction to major operating sys-

Department of Computer Science

tems and their components. Topics include processes, concurrency and synchronization, deadlock, processor allocation, memory management, I/O devices and file management, and distributed processing. Techniques in operating system design, implementation, and evaluation. Prerequisite: 91.305 3 cr

91.404 Analysis of Algorithms

Development of more sophisticated ideas in data type and structure, with an introduction to the connection between data structures and the algorithms they support. Data abstraction. Controlled access structures. Trees, lists, graphs, arrays; algorithm design strategies: backtracking, greedy strategy, divide and conquer, branch and bound. Elementary techniques for analysis: recursion equations, estimation methods, elementary combinatorial arguments. Examination of problem areas such as searching, sorting, shortest path, matrix and polynomial operations, and the indicated representations and algorithms. The student will use the techniques learned in this course and in previous courses to solve a number of logically complex programming problems. Prerequisites: 91.201, 92.322 3 cr

Computer Science Electives**91.309 Database I**

This course surveys topics in database management systems. Topics include access methods, data models (network, hierarchical, relational, semantic, and object-oriented), query languages, database design, query optimization, concurrency control, recovery, security, integrity, client-server architecture, and distributed database systems. A database application project will be assigned. Prerequisite: 91.204 3 cr

91.310 Database II

Advanced topics in database systems, including distributed database systems, query optimization, concurrency control, knowledge bases, deductive extendibility, and object-oriented database systems. Additional topics may include benchmarking, scientific databases, and database engines. Software engineering principles will be applied to the development of components of a database management system. Prerequisite: 91.309 3 cr

91.321 Network and Systems Management

This course will cover technical aspects of and VMS, and will prepare the student to manage a complex, heterogeneous computing environment. Students should expect substantial amounts of experience with all activities related to the management of the Computer Science Department network. 3 cr

91.350-91.354 Selected Topics

Depends on faculty interest, student demand, and developments in the field. May include: file management, software tools. Prerequisite: junior status Variable 1-3 cr

91.353 GUI Programming I

This is a first course in the design and implementation of graphical user interfaces for windowing environments. Prerequisites: 91.201, good programming and documentation skills 3 cr

91.401 Software Project Lab I

Specification, design, and implementation of a one- or two-semester software project proposed to a directing faculty member. Projects may be proposed as a one- or two-semester effort based on faculty approval. A two-semester effort requires subsequent registration for 91.402. Prerequisite: Students must submit a proposal to the directing faculty member, obtain his/her signed approval, and forward a copy of the signed proposal to department chairperson 3 cr

91.402 Software Project Lab II

A continuation of 91.401. Students must submit a proposal to the directing faculty member, obtain his/her signed approval, and forward a copy of the signed proposal to the department chairperson. Prerequisite: 91.401 3 cr

91.403 Operating Systems Practicum

Construction of real operating systems. Topics will include case studies of systems such as UNIX, MULTICS, and CP/M; structured design; and performance techniques. Group projects will be employed to design, build, and evaluate various operating systems modules. Prerequisites: 91.308 and permission of instructor 3 cr

91.405 Parallel Processing

A study of parallel architectures and parallel algorithms, including classification of architectures, characterization of perfor-

mance, design of parallel algorithms, evaluation of parallel software, and languages for parallel processing. Students will write and execute programs for several different parallel machines. Prerequisite: 91.308 3 cr

91.406 Introduction to Compiler Writing

Includes both theory and practice. A study of grammars—specification and classes; the translation pipeline: lexical analysis, parsing, semantic analysis, code generation and optimization; and syntax-directed translation. Use of automatic generation tools in the actual production of a complete compiler for some chosen language(s). Prerequisites: 91.204, 91.301 3 cr

91.412 Software Engineering

Software development methodologies for large-scale systems. Project organization, life cycle concept, data modeling, structured analysis and design, information hiding, and the use of computer-aided software engineering (CASE) tools. Team projects are required; these emphasize the design, documentation, and maintenance of complex software systems. Not open to students who have taken 91.523 Software Engineering I. Prerequisites: 91.201, 91.204, permission of instructor 3 cr

91.413 Data Communications I

Techniques of data transmission over analog lines. Properties of communication channels. Error control techniques. Line-, message-, and packet-switching techniques. Communication software architectures. Prerequisites: 91.204, 91.305 3 cr

91.414 Data Communications II (Distributed Systems)

Emphasis on local area networks and communication protocol architectures. A laboratory with RS232-based token ring network and UNIX sockets. Prerequisites: 91.308, 91.413 3 cr

91.415 Office Automation

Office information and decision support systems. Data and records management, electronic filing and retrieving systems, word processing, telecommunications, local area networking. Prerequisites: 91.201, 91.413 3 cr

91.420 Artificial Intelligence

LISP. Tree and graph searching algorithms: breadth first, depth first, uniform cost. Heuristic search methods. admissibility. Games: mini-max, alphabeta. Theorem-

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proving and question-answering.
Prerequisite: 91.301 3 cr

91.421 Knowledge-Based Systems

Other topics in artificial intelligence not covered in 91.420, such as computer vision, speech recognition, robotics, expert systems, computer art, computer music. Prerequisites: 91.420 and permission of instructor 3 cr

91.422 Computer Vision

An introductory course in computer vision. This course covers all the recognized computational aspects of vision. It presents computational techniques whenever possible, formulae, algorithms, and programs. Psychological theories are covered only to the extent that they have clear computational implications. Prerequisite: permission of instructor 3 cr

91.425 Symbolic Mathematical Computation

The use of computer algebra systems such as MACSYMA and REDUCE. Algorithms for exact computation in the integers, the ring of polynomials, finite fields, and field extensions. Greatest common divisor algorithm and polynomial factorization algorithms. Transcendental function arithmetic. Symbolic integration algorithms. Prerequisite: permission of instructor 3 cr

91.427 Computer Graphics I

Introduction to graphics systems and concepts. History of graphics. Introduction to hardware, software, and mathematical tools. GKS, CGI, and other graphics languages. Graphics data structures and modeling. 2D mathematical tools for modeling and viewing. Input, archiving, and display architectures. 2D graphical algorithms and data structures. 3D mathematical tools (algorithms and data structures) for modeling and viewing. Introduction to hidden line and hidden surface removal. Prerequisites: 91.201, 92.231 3 cr

91.428 Computer Graphics II

An advanced course in computer graphics for students familiar with basic issues in computer graphics. Details on hidden line and surface removal. PHIGS and other modeling languages. Data structures for 3D modeling. 2D and 3D curve and surface generation. Rendering, illumination, and color models. Realism through precision (ray tracing) and imprecision (fractals). Windowing and user interface

management systems. Modern hardware architectures. Animation and simulation systems. Prerequisite: 91.427 3 cr

91.430 Semantics of Programming Languages

Introduction to the Semantics of Programming Languages. Axiomatic, operational, denotational, and translational semantics. Program specification. Program proofs using the techniques of Floyd and Hoare. Prerequisites: 91.301 and 91.304 3 cr

91.450 Robotics I

The factories of the future (FOF) will require an integration of knowledge and experience from a variety of engineering and science disciplines. Further, the FOF will be strongly information driven and will involve artificial intelligence, machine vision, and robotics. This design course will feature projects and laboratory work at the bench top and prototype level in flexible manufacturing. The projects will involve using and programming robotics and designing of parts orientation and delivery systems. Simple CAD/CAE/CIM systems will also be developed to support the operation of the FOF. Prerequisites: junior standing in Computer Science or Engineering 3 cr

91.451 Robotics II

A continuation of 91.450. Prerequisite: 91.450 3 cr

91.452 Diagnostic and Test Software Design

Virtually all major hardware products include the design and implementation of diagnostic and verification software as part of the product life-cycle. This course will examine the details of such test software and the diagnostic software for various hardware devices such as disk and tape subsystems. Prerequisite: 91.201, 91.204, 91.305. 3 cr

91.453 Real-Time Programming

A survey of the programming techniques needed for applications in which a computer monitors or controls a process whose logical sequence is asynchronous to that of the computer. Topics covered include polling, single and multiple interrupts, masked and vectored interrupts, synchronization mechanisms, critical sections, hardware interfaces, sampled-data systems, and feedback and control. Students will implement several micro-

processor-based applications.
Prerequisites: 91.308, 16.267 3 cr

91.456 Speech Recognition and Synthesis

This course surveys the techniques by which computer systems can generate and recognize human speech. Students will be introduced to all aspects of this interdisciplinary field (including computer science, artificial intelligence, acoustics, linguistics, psychology, physiology, physics, and signal processing). Working in teams, students will implement parts of a modern speech system and explore the capabilities and limitations of present day technology. Prerequisite: permission of instructor 3 cr

91.457 Computer Security

Basic concepts of cryptography, data security, information theory, complexity, number theory, and finite field theory; encryption algorithms including the Data Encryption Standard (DES) and public key systems; incorporating cryptographic controls into computers; key management; access controls; information flow controls; and inference controls. Prerequisites: 91.404, 92.322, 92.386 3 cr

91.458 Computer Performance Evaluation

The objectives of this course are: 1) to provide both analytic and simulation skills useful in evaluating a computer system, and 2) to study available techniques of modeling a given system so that meaningful statistics (such as response times) can easily be obtained. The course will cover the following major areas: 1) review of probability theory and statistics; 2) queuing theory; 3) performance evaluations of time-sharing, batch, or mixed computer systems; 4) performance evaluations of distributed systems. Other topics such as performance measurement techniques, and data analysis will also be covered. Prerequisites: 91.308, 92.386 3 cr

91.459 Human Factors in the Design of Interactive Systems

This course sensitizes students to the factors one must consider in designing interactive systems. Gives them experience in developing interactive software for use by people other than themselves, and discusses tools and techniques for evaluating the effectiveness of interactive software. Course work consists of readings, class discussions, the researching and writing of a term paper, and the design and imple-

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mentation of an interactive programming project. Prerequisite: 91.201 3 cr

91.460 Selected Topics

Depends on faculty interest, student demand, and developments in the field. May include: computability, formal languages, automata, VLSI design, computer aided design (CAD), computer aided instruction (CAI), semantics of programming languages. Prerequisites: Senior status, permission of instructor Variable 1-3 cr

91.461 GUI Programming II

A second course in the design and implementation of graphical user interfaces for windowing environments. Prerequisite: 91.353 3 cr

91.490 Directed Studies in Computer Science

Individual study for a student desiring more advanced or more specialized work. This course may not be taken more than twice and may not be substituted for scheduled offerings. Prerequisite: Students must submit a proposal to the directing faculty member, obtain his/her signed approval, and forward a copy of the signed proposal to the department chairperson 3 cr

Courses for Nonmajors

These courses do not count as Computer Science major courses. You may receive general-elective credit for them. However, you may not receive credit for any of these courses after you have taken Computing I. In addition, Continuing Education offers many courses with Computer Science course numbers that are not open to computer science majors.

91.111 Computing in the Everyday World

A non-technical introduction to computer science. The historical development of computational aids and their use in various cultures and societies. Modern examples of computational aids, including integrated word processing/ spreadsheet/ database environments. 3 cr

91.113 Exploring the Internet

This course covers the tools needed to navigate the Internet: e-mail, telnet, and ftp; listservs and Usenet news; andarchie, WAIS, Gopher, the World-Wide Web, and Mosaic. This course also gives students basic computer programming skills and sufficient knowledge of UNIX to use

Internet tools confidently and efficiently 3 cr

91.114 Advanced Internet

A continuation of 91.113, Exploring the Internet. Advanced topics for experienced Internet users, including setting up Internet connections, creating Web pages that incorporate images and sound, building your own Internet information site, and using the advanced features of the standard Internet tools. Students will learn and use the full capabilities of HTML (HyperText Markup Language). Each student will carry out a substantial final project. Prerequisite: 91.113 3 cr

91.115 Developing Database Applications

How to design and implement a complete database application using a modern relational database system. Relations, queries, forms, and reports. Objects and properties. Data design and software design. Rapid application development tools. Prerequisite: experience using Microsoft Windows® 3 cr

91.263 FORTRAN Programming

An introduction to computer programming using FORTRAN 77. Programming arithmetic, decisions, repetition, and input/output. Arrays and array processing, including simple algorithms for searching and sorting. The edit-compile-test cycle. 3 cr

Department of Criminal Justice

Dr. Eva S. Buzawa, Chairperson

Coordinator of the Graduate Program: Alan J. Lincoln

Professors: Eva S. Buzawa, James M. Byrne, Gerald F. Hotelling, Renée G. Kasinsky, Alan J. Lincoln, Joseph W. Lipchitz, Larry Siegel

Assistant Professors: Carolyn Petrosino

Criminal Justice Major

The University of Massachusetts Lowell offers a Bachelor of Science degree in Public Service with a concentration in the Administration of Criminal Justice. This program offers a strong concentration in professional courses while simultaneously assuring the student a traditional, well-rounded liberal arts education. The typical student takes between 36 and 48 credits in professional courses. In addition, students majoring in the Administration of Criminal Justice will fulfill a professional skills requirement. This consists of either attaining intermediate proficiency in a modern foreign language, or completing four courses in computers and statistics. In the event the student chooses the foreign language skill, the University recommends Spanish.

Students wishing to transfer into the Criminal Justice from another major, or from another accredited institution, must present either an associate degree or a grade point average of at least 2.5 on a 4.0 scale.

Basic Requirements

The major in the Administration of Criminal Justice major consists of at least 36 credits in criminal justice courses, of which at least five courses shall be at the 300 course level or above.

1. Required Courses (15 credits)

- 44.101 The Criminal Justice System
- 44.221 Criminology
- 44.234 Criminal Law
- 44.390 Intro to C.J. Research
- 44.494 Criminal Justice Field Seminar I and

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44.495 Criminal Justice Field Internship II (Students will select 44.494 and 44.495 simultaneously) or

44.496 Criminal Justice Practicum*

*Students in the evening school will substitute either 44.370 C.J. Management or 44.371 C.J. Planning for 44.496.

44.490 C.J. Research Honors Seminar**

**recommended for those students who plan to further their careers in graduate school.

Please note that from among all electives, either collateral or free electives, that the student presents for graduation, at least two must be at the 300 or 499 level. A 2.0 cumulative average overall and a 2.2 average in the major are necessary for graduation.

2. Skills Requirement

Students majoring in the Administration of Criminal Justice are required to meet proficiency standards in one of the following:

Intermediate proficiency in a modern foreign language, preferably Spanish, (Students should consult policies in the University Catalog under the heading of University Academic Policies: Language Requirement for a list of avenues by which certification of language proficiency may be pursued.) or Computer Programming and Statistics proficiency to be demonstrated by passing a minimum of four courses (12 semester credits) in the mathematics department from the following approved list:

44.201 Computer Applications in C.J. or equivalent

Plus one of the following:

91.113 Exploring the Internet or
91.115 Database Applications

Then the student completes the requirement by taking the following:

92.183 Intro to Stats and, either
92.363 Data Analysis or
43.335 Quantitative Methods

There is no prohibition against completing both options in the professional skills area. Students who fulfill the requirements of either the minor in Mathematics with the Computer Science option, or the requirements for the certificate in computer proficiency offered by the Mathematics

Department will automatically fulfill the skills requirement.

3. Collateral Requirements

In addition to the major courses and the professional skills area, the student majoring in the Administration of Criminal Justice will select six courses from an approved list of correlative courses. Courses used to fulfill the professional skills requirement may be used toward fulfillment of this requirement. The following is a list of suggested correlative courses from which Criminal Justice majors may choose:

41.261 Introduction to Legal Concepts
41.262 Introduction to Business Law
41.363 Corporate and Property Law
41.369 Courts and the Constitution
41.376 Family Law
41.381 Women in the Law
41.383 Alternative Dispute Resolution
42.382 Crime in Literature
43.216 American Urban History I
43.217 American Urban History II
43.268 History of Family & Childhood in the U.S.
43.308 Hist/Crime, Confl & Soc Contr U.S.
43.335 Quant Methods in History & Soc
43.349 Engl Constitutional & Legal History
45.203 Introduction to Ethics
46.105 Intro to Public Policy
46.202 Practical Public Affairs
46.265 State and Local Politics
46.270 Legislative Politics
47.260 Human Development I
47.360 Human Development II
47.272 Abnormal Psychology
47.360 Human Development II
47.364 Psychology of Crime and Corrections
48.231 Sociology of the Family
48.234 Study of Minorities
48.235 Black Experience in American Life
48.255 Sociology of Deviance
48.256 Political Sociology
48.341 Social Stratification
48.345 Urban Sociology
48.361 Sociology of Law & the Criminal Justice System
48.402 Social Research
92.183 Introduction to Statistics
92.263 FORTRAN Programming
92.265 Pascal
92.363 Data Analysis
46.356 Public Policy Analysis

46.360 Public Administration
46.345 Constitutional Law and Politics
46.347 Civil Liberties, Law and Politics
46.355 Government Fiscal Policy
47.232 Psychology of Personality
46.410 Reading Seminar in Judicial Review
47.163 Human Life Span
47.209 Social Psychology
91.113 Exploring the Internet

Students who transfer to the Criminal Justice major or to the College of Arts and Sciences with the intention of subsequently declaring this major must make individual arrangements with the Department Chairperson regarding satisfaction of major and collateral course requirements.

For the student who wishes to prepare as completely as possible, UMass Lowell is particularly well-suited for providing the student with a Mathematics minor - Computer option, a carefully selected arrangement of courses from the College of Management, the opportunity for a second major in Political Science, Psychology, Sociology, or any other field of study offered by the UMass Lowell. (See regulations of the College of Arts and Sciences governing minors.)

Program Tracks

The following tracks are offered as a suggestion. Students who do not wish to follow a specific track are under no obligation to do so.

Enforcement: Suggested Courses

44.101 The C.J. System
44.141 Police Functions
44.201 Computer Applic C.J.
44.221 Criminology
44.233 Criminal Procedure
44.234 Criminal Law
44.243 Criminalistics I
44.244 Criminalistics II
44.261 Juvenile Delinquency
44.341 Comparative Police Sys
44.370 C.J. Management
44.371 C.J. Planning
44.373 Issues in Police Admin
44.390 Intro to C.J. Research
44.490 C.J. Research Seminar
44.494 Field Seminar and
44.495 Field Internship or
44.496 Practicum

Corrections: Suggested Courses

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- 44.101 The C J System
- 44.201 Computer Applic CJ
- 44.251 Institutional Corrections
- 44.221 Criminology
- 44.233 Criminal Procedure
- 44.234 Criminal Law
- 44.331 Penal Law
- 44.351 Community Based Corrections
- 44.370 CJ Management
- 44.371 CJ Planning
- 44.372 Issues in Corr Admin
- 44.390 Intro to C J Research
- 44.490 C J Research Seminar
- 44.494 Field Seminar and
- 44.495 Field Internship or
- 44.496 Practicum

Law and the Courts: Suggested Courses

- 44.101 The C J System
- 44.221 Criminology
- 44.201 Computer Applic CJ
- 46.230 Law and the Legal System
- 44.233 Criminal Procedure
- 44.234 Criminal Law
- 44.261 Juvenile Delinquency
- 44.321 Criminology II
- 44.331 Penal Law
- 44.335 Juvenile Court: Philosophy and Practice
- 44.360 Gender, Race, and Crime
- 44.370 C J Management
- 44.371 C J Planning
- 44.390 Intro to C J Research
- 44.490 C J Research Seminar
- 44.494 Field Seminar and
- 44.495 Field Internship or
- 44.496 Practicum

Criminal Justice (Course Prefix: 44)**44.101 The Criminal Justice System**

This course includes a brief history of the criminal justice system and an analysis of its structure and function. This course is required of all majors and is a prerequisite for all other courses in criminal justice. 3 cr

44.141 Police Process

An examination of the historical development of police work with special emphasis on the conflicting role expectations facing the police officer. 3 cr

44.201 Computer Applications in Criminal Justice

This course is designed to provide the student with an introduction to the use and application of computers and computer

programs. This is a laboratory course. 3 cr

44.208 Crime and Punishment - Comparisons and Contrasts

This course will examine the historical and social development of crime and punishment as seen in its western cultural context. Examples and developments from other cultures will be examined for purposes of compassion and perspective. 3 cr

44.221 Criminology I

The definition and nature of crime, criminal statistics, and a survey of the theories of crime causation are included. Required of all majors. 3 cr

44.233 Criminal Procedure

This law course deals with the workings of the legal system as they pertain to the criminal justice professional. Particular emphasis is placed on the proper legal procedures leading up to and including court proceedings. 3 cr

44.234 Criminal Law

The historical origins and development of criminal law from the early common law to contemporary decisions and statutes. Constitutional and statutory factors as they pertain to crime, defense, and crimes against persons and property are considered. In addition, attention is directed toward limitations of criminal responsibility, capacity and the law of arrest. Sections of the Massachusetts Criminal Code and other statutes are covered where applicable. 3 cr

44.235 Constitutional Law

Explores the major constitutional law cases of the past decade and examines their collective impact on the criminal justice system. 3 cr

44.241 Principles of Investigation

Gives the student a solid understanding of the organization, techniques and procedures associated with a proper criminal investigation. The course will include such topics as arson, larceny, sexual offenses, forgery, and fraud. Other important aspects will include the establishment of investigative priorities, fiscal restraints, and informal management. 3 cr

44.243 Criminalistics I

This laboratory course will cover a basic procedures in arrest, search and seizure, and the gathering and evaluation of evidence as to admissibility, weight and com-

petence. Prerequisite: two semesters of science. 3 cr

44.244 Criminalistics II

This laboratory course concerns the collection, identification, preservation and transportation of physical evidence. The crime laboratory and its effectiveness, capabilities and limitations in assisting the police officer in utilizing physical evidence as a means of apprehension and/or conviction are carefully examined. Prerequisite: 44.243 3 cr

44.247 Federal Law Enforcement

A wide range of federal law enforcement (e.g. FBI, IRS, SEC) are examined, focusing on such basic issues as structure, purpose, power, and overall effectiveness. 3 cr

44.251 Institutional Corrections

This course will focus on the assessment of the U. S. prison system and jail system, highlighting such topics as 1) changing offender priorities, 2) institutional crowding, 3) violence in prison, 4) the privatization of prisons, 5) the rediscovery of treatment, and 6) furlough policy. 3 cr

44.261 Juvenile Delinquency

Causative factors in the development of youthful offenders are examined. The development of the juvenile court, training schools, and contemporary innovative practices are covered. 3 cr

44.321 Criminology II

This class explores the social, political and personal context of theory development, focusing on a full range of criminological theories (e.g. classical, biological, psychological, and sociological theories of crime causation). Prerequisite: 44.221 3 cr

44.326 Hate Crime

The issue of hate crime is examined, focusing on federal and state statutory laws and the dynamics of police, court and corrections - based responses to the problem.

44.331 Penal Law

A study of the constitutional rights of incarcerated individuals including major policy issues and trends associated with recent revisions of penal codes which reflect court decisions for the preservation of offenders' rights. 3 cr

44.335 Juvenile Court: Philosophy and Practice

An examination of the philosophy and practice of juvenile justice in this country,

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focusing on key legal decisions (e.g. Kent, Gault, Winship, Schall v. Martin, Breed v. Jones), the movement to "criminative" the juvenile court process, and a review of recent innovations in juvenile court practices. Prerequisites: 44.234, 44.261 3 cr

44.341 Comparative Police Systems

A study of various police systems on the national and international level and a comparison with local systems on the basis of organization, structure, and administration of law enforcement. Examines agencies in Great Britain, France, Russia and the United States. 3 cr

44.342 British Criminal Justice System

This study of the British Criminal Justice System is offered alternating summers in conjunction with the faculty of Oxford University. The program includes travel and intensive lectures and on-site study of the various aspects of the British Criminal Justice System. Lectures by Oxford University faculty are coordinated with the on-site inspections. Oxford University's library resources are available to the student to help in the preparation of a required research paper. 6 cr

44.347 Community Policing

Community policing philosophy, applications, issues, and contemporary research. Community policing models. 3 cr

44.349 The Courts

An examination of the organization, administration, and effectiveness of federal, state, and local court systems. 3 cr

44.351 Community Based Corrections

This course will provide a comprehensive review of the use of community-based sanctions and community-based early-release mechanisms. In addition to traditional probation and parole topics, we examine such topics as an assessment of "new" intermediate sanctions, electronic monitoring, intensive supervision, boot camps, day fines, day reporting centers, and community service sentences. 3 cr

44.360 Gender, Race and Crime

The gender and racial implications of criminal laws, criminal justice practices and programs are examined. The impact of historical and present day institutional practices are analyzed on the basis of race and gender. The position of women and racial/ethnic minorities are presented

from the different perspectives of victims, offenders and criminal justice practitioners. Prerequisites: 44.234 and 46.345 or 46.347 3 cr

44.370 Criminal Justice Management

An introduction to the principles of management including planning, budgeting, grantsmanship, and evaluation relating to the criminal justice manager. 3 cr

44.371 Criminal Justice Planning

A continuation of Criminal Justice Management with a particular emphasis placed upon student design and evaluation of programs and plans. Prerequisite: 44.370 or equivalent. 3 cr

44.372 Issues in Correctional Administration

Specific analysis of the management of correctional institutions including custody, classification, reception, programming, release, staffing, scheduling, collective bargaining, and other related issues. Prerequisite: 44.370 or equivalent 3 cr

44.373 Police Administration

Specific analysis of the management of contemporary police forces including staffing, scheduling, training, collective bargaining, community relations and other related issues. Prerequisite: 44.370 or equivalent 3 cr

44.377 Technology and Crime

This course examines law enforcement technologies related to equipment used in technical investigations. Time is spent both in and out of the classroom developing an understanding of the technologies and basic techniques of technical investigations. 3 cr

44.380.201 Hate Crimes

Hate crimes illustrate bigotry plus criminal acts. This course examines prejudice as a motivation for criminal behavior. The criminological theory for hate crime is reviewed, as well as historical perspectives of this crime category. This is a rich and comprehensive exploration that begins with understanding the psychology of prejudice and ends with reviewing genocide as mass hate crime. 3 cr

44.380.202 Ethics in Criminal Justice

This course seeks to explore common dilemmas experienced by criminal justice practitioners, within the context of moral theory. A principal objective is to raise the

profile of consequentialism from actions undertaken in the daily workings of the criminal justice system. 3 cr

44.385 Crime and Mental Illness

A consideration of the realities and myths surrounding the relation between mental illness and crime. An analysis of case studies and other relevant material from criminal justice and psychology is a major component of this course. 3 cr

44.390 Introduction to Criminal Justice Research

An introduction to research methods for the criminal justice professional including terminology, standard methodologies, and elementary statistics. 3 cr

44.394 Sex Offenses and Offenders

This course will examine the origins and dynamics of sexual crime. Special emphasis will be placed on how these offenses are defined and handled in Massachusetts. Class content will also cover theories of sex crime, offender classification systems and treatment programs, and criminal sexual psychopathy laws. 3 cr

44.401 Drugs and the Criminal Justice System

This course is designed to cover the problem of drugs, drug abuse and the law and its application. Treatment of and alternatives to drug rehabilitation are studied in addition to the classification, identification, distribution and control of drugs. 3 cr

44.406 Senior Honors Project 3 cr**44.410 Women and Criminal Justice**

Feminist and other theories explaining women's victimization and criminality. Women's experiences as victims, offenders and criminal justice employees. Laws and their effects on the rights of women in the criminal justice system. 3 cr

44.423 Elite Deviance and Crime

This course examines the systematic violation of the laws and ethics of business and politics. The impact of corporate crime and deviance on society and the societal and legal reactions is explored. 3 cr

44.477 Domestic Violence

This course examines the causes and consequences of domestic violence and the latest research regarding the responses by the criminal justice system. 3 cr

*Department of Criminal Justice***44.490 Criminal Justice Research Seminar**

Specific practice in the definition, design, and execution of a research project, and an analysis of the impact of contemporary criminal justice research on policy development. Prerequisite: 44.390 3 cr

44.493 Computer Crime and Security

An examination of the causes and consequences of computer crime as well as the criminal justice system's responses to the problem. 3 cr

44.494 Criminal Justice Field Seminar I

The seminar component of the internship program provides the opportunity to apply organization analysis and theory to the student's observations of the host agency. The dynamics of organizations, their processes and structures are examined by applying critical thinking skills. 3 cr

44.495 Criminal Justice Field Seminar II

The seminar component of the internship program provides the opportunity to apply organization analysis and theory to the student's observations of the host agency. The dynamics of organizations, their processes and structures are examined by applying critical thinking skills. 3 cr

44.496 Practicum

Assigned field work under the supervision and with the permission of the instructor assigned to the course. The purpose is to broaden the educational experience of the pre-service students in law enforcement, probation, and correctional agencies within the area. This course is designed to provide a correlation of theoretical knowledge with practical experience in an area of particular interest to the student. 3 cr

44.560 Gender, Race and Crime

This course examines some of the key issues underlying criminal violence focusing on the inequalities based on gender, race, and class. Feminist theory as well as traditional theories will be used to examine how violence based on gender, race and class is perpetuated and maintained. Key contested issues involving sexual harassment, race, and the death penalty crimes of bias based on race and gender and white collar crimes will be examined in the contexts of the criminal justice system and the community. 3 cr

44.623 Child Maltreatment

This course is designed as an overview of

the criminal and non-criminal victimizations that occur to children and adolescents in the United States and elsewhere. The newest data will be presented on forms of child maltreatment such as child physical abuse, sexual abuse, child neglect, family and non-family abduction, other criminal victimizations and the harms experienced by children in institutionalized settings. Topics to be examined will be the theories of and risk factors associated with child maltreatment, its physical and psychological consequences, and the response to child maltreatment by the criminal justice system and other agencies and organizations concerned with the well-being of children and youth. 3 cr

44.624 Victimology

This course examines the patterns of victimization, the characteristics and lifestyles of crime victims, and the impact of their victimization. The treatment of victims by the Criminal Justice System is examined along with possible reforms in these approaches. 3 cr

Department of Environmental, Earth, and Atmospheric Sciences

Arnold L. O'Brien, Chairperson

Professors: Frank P. Colby, Jr., Robert C. Curtis (Emeritus), G. Nelson Eby, Arnold L. O'Brien, Bodo W. Reinisch, Wen Tang (Emeritus)

Associate Professors: Robert R. Gamache, Dan S. Golomb, Richard Z. Gore

The Department of Environmental, Earth, and Atmospheric Sciences offers programs of study which provide a firm base in science and mathematics and a broad understanding of the natural environment. The programs are multidisciplinary in approach, and the composition of the faculty, geologists, geophysicists, chemists and meteorologists, reflects this multidisciplinary character. Three program concentrations are offered within the Bachelor of Science degree in Environmental Science: Atmospheric Science, Environmental Studies, and Geoscience. The aim of the program is to successfully prepare students for graduate school and for careers

in research labs, industry, consulting and weather forecasting firms, and state and federal governmental agencies such as DEP and EPA. All the concentrations were founded more than 20 years ago and graduates of the program have achieved considerable success in the environmental and meteorological fields. Internships are available with many private and governmental organizations. These provide the student with practical experience and potential entry into the job market. Undergraduate research is also encouraged and students in the department are active participants in the University's Honors Program.

The department has over 30 PC Macintosh, and Unix based computer systems and work stations and a wide variety of software applications and languages, such as air-pollution and weather models, FORTRAN and C/C++ compilers, Mathematica and Maple computer mathematics systems. Geographic Information Systems, word processing, spread sheets and databases are available. Also housed in the department is a weather center with satellite links and remote observation platforms, an air pollution laboratory, a chemistry laboratory for environmental analysis, an instrumental neutron activation analysis laboratory used to measure trace constituents in natural samples, and a fission-track geochronology laboratory. In addition, faculty in the department are affiliated with the Center for Atmospheric Research, the Center for Environmental Engineering and Science, and the Radiation Laboratory, and maintain active collaborations with other universities and research facilities.

There are a number of student organizations in the department. The student chapter of the American Meteorological Society, a national organization, serves as a focal point for those students interested in the atmospheric sciences. The Society of Environmental Scientists encompasses students interested in a broad range of environmental activities and issues. Sigma Gamma Epsilon is a national earth science honorary society open to all qualified students. These student organizations sponsor speakers, organize field trips, and provide career and job placement seminars.

The department also provides core courses for the University's general education program encouraging intellectual inquiry into

the critical issues of the earth and the environment. Such courses recognize the fact that the understanding of environmental processes is fundamental to ecologically sound and sustainable development in a variety of fields.

Bachelor of Science in Environmental Science

The major in Environmental Science is a broad-based interdisciplinary program designed to provide students with an understanding of the complex interrelationships which exist between the lithosphere, hydrosphere, biosphere, and atmosphere. A basic understanding of science and mathematics is fundamental to the program, and all concentrations require one year sequences in physics, chemistry, and calculus plus additional science and mathematics courses as appropriate for the particular concentration. A three course sequence (Principles of Earth & Environmental Systems I & II and Environmental Geochemistry) provides an integrated understanding of the behavior of natural systems, a preliminary step to more focused study of a particular aspect of the natural environment. The program diverges at this point with students interested in the atmospheric environment and meteorology following the Atmospheric Science Concentration, those interested in the geologic environment following the Geoscience Concentration, and those interested in both the scientific and social aspects of environmental problems following the Environmental Studies Concentration.

The degree program also provides the basic course work, with a few additional courses required depending on the concentration, for students who wish to pursue a career in earth science teaching. For students interested in this career path, the College of Education offers a graduate degree program designed to prepare elementary and secondary teachers in earth sciences. This year-long program (September to June) provides the course work and the apprentice teaching experience required for certification in Massachusetts and thirty-three other states (see the Graduate Catalogue for admission requirements). Additional information may be obtained from the College of Education.

Atmospheric Science Concentration

The Atmospheric Science concentration focuses on meteorology, but also includes components dealing with atmospheric physics and chemistry, solar-terrestrial and ocean-atmosphere interactions, air pollution and air pollution control, and global climate change due to man-made emissions. The goal of the program is to provide students with the knowledge of the fundamental principles and techniques of physics and mathematics which are necessary for understanding atmospheric behavior and for solving practical problems concerning weather, climate and air pollution. Because atmospheric science is primarily the application of the principles and techniques of physical sciences to the study of the atmosphere, the curriculum specifies a substantial core of supporting science and mathematics courses.

Historically, meteorology has been the primary employment field for graduates of this concentration. The meteorologist studies the physical causes of weather and climate and applies this knowledge to the solution of practical problems ranging from the forecasting of weather to the analysis of the influence of weather and climate on public health, agriculture, engineering, industry and commerce, and national defense. The more broadly trained atmospheric scientist will also find opportunities in the fields of air pollution research and control. Meteorologists and Atmospheric Scientists are employed by the agencies of the federal government, the National Oceanic and Atmospheric Administration, the National Weather Service, and the Department of Defense, as well as by agencies of state and local governments, and by commercial aviation companies and private consulting firms.

A significant number of students who graduate from this concentration continue their education by attending graduate school. Atmospheric Science majors who wish to continue their studies at the graduate level are advised to develop competencies in science and mathematics, especially in computer science, beyond the required science and mathematics core.

Environmental Studies Concentration

The field of environmental science is interdisciplinary in nature. This concentration blends a strong science core with focused areas in the humanities/social sciences leading to a program of study that is compatible with the student's strengths and goals. The science focus can be in either biology or chemistry. The choice of a humanities/social sciences focus will depend on the student's interests.

This concentration prepares the student for employment in the private and government sector, where knowledge is required in management and protection of the environment, environmental laws and regulations, natural resources, and environmental economics. Graduates of this concentration can have a variety of career experiences. Several are doctors and environmental lawyers. Some are teachers. Others work as environmental analysts, planners, water treatment plant operators, hydrological consultants, noise and air pollution specialists, and as managers in private industry and government. This concentration will also prepare the student for graduate work in environmental science.

Geoscience Concentration

This concentration is aimed at students who have an interest in the physical environment, but desire a broader preparation than that of the traditional geology major. The concentration is centered around a strong geoscience core, but includes additional course work in the biological sciences, hydrogeology and hydrochemistry, and geographical information systems. Thus the student will not only be preparing for entry into the traditional areas of geological employment (petroleum and mining) but also for the expanding opportunities in hydrogeology, hazardous waste assessment and management, groundwater remediation, wetlands delineation and evaluation, and environmental management. This concentration is also recommended for students who might wish to obtain certification as earth science teachers.

Graduates of this concentration are qualified for a number of different types of employment opportunities. Previous graduates have found employment in the

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petroleum industry, in asbestos identification and remediation, as analytical specialists in environmental testing laboratories, and in the field evaluating hazardous waste sites and ground and surface water contamination. This concentration also provides the requisite course work for students who wish to pursue a graduate degree in environmental science or geology.

Degree Requirements for Atmospheric Science Concentration

I. General Education Requirements (24 credits)

Aesthetics	3 cr
Behavioral and Social Sciences	6 cr
College Writing	6 cr
Historical Studies	3 cr
Literature	3 cr
Values, Concepts, and Choice	3 cr

87.104 Foundations of Conservation & Environmental Concern recommended for ES majors.

II. Major Field Requirements (93 credits)

A. Environmental Science 13 cr

87.101 Environmental Science Seminar	1 cr
87.201 Prin. of Earth & Envir. Systems I	4 cr
87.202 Prin. of Earth & Envir. Systems II	4 cr
89.315 Environmental Geochemistry	4 cr

B. Atmospheric Science 43 cr

85.102 Weather Forecasting Seminar I	1
85.302 Atmospheric Dynamics	3
85.304 Methods in Meteorology I	3
85.305 Methods in Meteorology II	3
85.306 Environmental Problem Solving	3
85.308 Forecasting and Synoptic Tech. I	3
85.309 Forecasting and Synoptic Tech. II	3
85.315 Advanced Atmospheric Dynamics I	3
85.316 Advanced Atmospheric Dynamics II	3
85.403 Physical Meteorology	3
85.483 Solar-Terrestrial Relations	3
85.571 Air Pollution Phenomenology	3

Atmospheric Science Electives Select three of the following:

85.313 Physical Climatology	3
85.340 Tropical Meteorology	3
85.350 Satellite and Radar Meteorology	3
85.360 Upper Atmosphere Meteorology	3
85.410 Advanced Forecasting	3
85.523 Air Pollution Control	3

C. Supporting Sciences and Mathematics 37 cr

92.131 Calculus I	4 cr
92.132 Calculus II	4 cr
92.231 Calculus III	4 cr
92.234 Differential Equations	3 cr
92.263 FORTRAN Programming	3 cr
92.386 Statistics for Sci & Eng	3 cr
95.201 Principles of Physics I	3 cr
96.103 Experimental General Physics I	1 cr
95.202 Principles of Physics II	3 cr
96.104 Experimental General Physics II	1 cr
84.121 Chemistry I	3 cr
84.123 Chemistry I Lab	1 cr
84.122 Chemistry II	3 cr
84.124 Chemistry II Lab	1 cr

III. Unrestricted Elective Courses (3 credits)

IV. Minimum 120 Credit Requirement

Degree Requirements for Environmental Studies Concentration

I. General Education Requirements (24 credits)

Aesthetics	3 cr
Behavioral and Social Sciences	6 cr
College Writing	6 cr
Historical Studies	3 cr
Literature	3 cr
Values, Concepts, and Choice	3 cr

87.104 Foundations of Conservation & Environmental Concern recommended for ES majors.

II. Major Field Requirements (93-95 credits)

A. Environmental Science 24 cr

81.315 Principles of Ecology	2 cr
81.317 Principles of Ecology Lab	2 cr
87.101 Environmental Science Seminar	1 cr
87.102 Environmental Problems Seminar	1 cr

87.201 Prin. of Earth & Envir. Systems I	4 cr
87.202 Prin. of Earth & Envir. Systems II	4 cr
87.406 Geographic Information Systems	3 cr
89.314 Hydrogeology	3 cr
89.315 Environmental Geochemistry	4 cr

B. Science Focus 14-16 cr

Majors in the Environmental Studies concentration must take a minimum of four courses (14 or more semester credits) from one of the following two categories. In addition to the courses listed below other courses may be substituted with the permission of the department program committee.

I. Biology

81.201 General Microbiology	3 cr
81.203 General Microbiology Lab	1 cr
81.215 Introduction to Marine Biology	3 cr
81.217 Introduction to Marine Biology Lab	1 cr
81.224 Intro to Insect Biology	3 cr
81.226 Intro to Insect Biology Lab	1 cr
81.306 Invertebrate Zoology	3 cr
81.308 Invertebrate Zoology Lab	1 cr
81.320 Botany	3 cr
81.322 Botany Lab	1 cr

2. Chemistry

84.207 Inorganic Chemistry	3 cr
84.209 Inorganic Chemistry Lab	1 cr
84.221 Organic Chemistry I	3 cr
84.227 Organic Chemistry I Lab	1 cr
84.222 Organic Chemistry II	3 cr
84.228 Organic Chemistry II Lab	1 cr
84.324 Principles of Analytical Chemistry	3 cr
84.325 Prin. of Analytical Chemistry Lab	1 cr
84.344 Physical Chemistry I	3 cr
84.346 Physical Chemistry I Lab	1 cr
84.345 Physical Chemistry II	3 cr
84.347 Physical Chemistry II Lab	1 cr

C. Humanities/Social Science Focus 18 cr

Majors in the Environmental Studies concentration must take a minimum of six courses (18 or more semester credits) from one of the following categories. Students must follow the prescribed program in each category. In addition to the courses listed below other courses may be substituted with the permission of the department program committee.

COLLEGE OF ARTS AND SCIENCES*Department of Environmental, Earth, and Atmospheric Sciences***1. Economics****Required courses:**

49.201 Economics I	3 cr
49.202 Economics II	3 cr
49.315 Intro. to Environmental Economics	3 cr

Select 3 courses from the following list:

49.303 Microeconomic Theory	3 cr
49.310 Eco. of Less Developed Countries	3 cr
49.328 Eco. of Energy and the Environment	3 cr
49.329 Environ. Cost-Benefit Analysis	3 cr
41.367 Environmental Law	3 cr
46.357 Science, Tech., and Public Policy	3 cr

2. English (communication)

42.222 Oral Communication	3 cr
42.225 Basic Technical Writing	3 cr
42.226 Tech. and Scientific Comm.	3 cr
42.229 Essay Writing for Non-majors	3 cr
42.324 Writing About Nature and the Env.	3 cr
42.390 Technical and Scientific Writing	3 cr

3. Legal Studies**Required Course:**

41.367 Environmental Law	3 cr
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Select 5 courses from the following list:

41.262 Business Law	3 cr
41.363 Corporate and Property Law	3 cr
41.365 The Legal Environment of Business	3 cr
41.366 International Law	3 cr
41.370 Real Estate Law	3 cr
41.379 The Rel. of Law, Logic and Ethics	3 cr
41.386 Intellectual Property	3 cr
41.387 Legal Research Methods	3 cr

4. Modern Languages

6 courses in one of the following languages: French, Italian, or Spanish

5. Political Science**Required courses:**

46.101 Introduction to American Politics	3 cr
46.357 Environmental Policy	3 cr

Select 3 courses from the following list:

46.105 Introduction to Public Policy	3 cr
46.205 Introduction to Political Economy	3 cr
46.335 State, Bureaucracy and Policy	3 cr

46.338 Political Participation	3 cr
46.340 Seminar in American Politics	3 cr
46.352 Science, Tech. and Public Policy	3 cr

Select 1 course from the following list:

46.265 Intro. to State and Local Gov.	3 cr
46.343 The Congress	3 cr
46.350 Urban Politics and Policy	3 cr
46.353 Public Admin. and Public Policy	3 cr
46.378 International Political Economy	3 cr

D. Supporting Sciences and Mathematics**37 cr**

92.131 Calculus I	4 cr
92.132 Calculus II	4 cr
92.183 Intro to Statistics or	3 cr
92.386 Statistics for Sci & Eng	
95.201 Principles of Physics I	3 cr
96.103 Experimental General Physics I	1 cr
95.202 Principles of Physics II	3 cr
96.104 Experimental General Physics II	1 cr
84.121 Chemistry I	3 cr
84.123 Chemistry I Lab	1 cr
84.122 Chemistry II	3 cr
84.124 Chemistry II Lab	1 cr
81.111 Principles of Biology I	3 cr
81.113 Principles of Biology I Lab	2 cr
81.112 Principles of Biology II	3 cr
81.114 Principles of Biology II Lab	2 cr

III. Unrestricted Elective Courses (1-3 credits)**IV. Minimum 120 Credit Requirement****Degree Requirements for Geoscience Concentration****I. General Education Requirements (24 credits)**

Aesthetics	3 cr
Behavioral and Social Sciences	6 cr
College Writing	6 cr
Historical Studies	3 cr
Literature	3 cr
Values, Concepts, and Choice	3 cr

87.104 Foundations of Conservation & Environmental Concern recommended for ES majors.	
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II. Major Field Requirements (94 credits)

A. Environmental Science	24 cr
81.315 Principles of Ecology	2 cr
81.317 Principles of Ecology Lab	2 cr

87.101 Environmental Science Seminar	1 cr
87.102 Environmental Problems Seminar	1 cr
87.201 Prin. of Earth & Environ. Systems I	4 cr
87.202 Prin. of Earth & Environ. Systems II	4 cr
87.406 Geographic Information Systems	3 cr
89.314 Hydrogeology	3 cr
89.315 Environmental Geochemistry	4 cr

B. Geoscience 33

89.201 Principles of Geology	3 cr
89.203 Principles of Geology Lab	1 cr
89.301 Mineralogy & Crystallography	3 cr
89.303 Mineralogy & Crystallography Lab	1 cr
89.304 Igneous & Metamorphic Petrology	3 cr
89.306 Igneous & Metam. Petrology Lab	1 cr
89.316 Geomorphology	3 cr
89.318 Geomorphology Lab	1 cr
89.322 Structural Geology	3 cr
89.324 Structural Geology Lab	1 cr
89.326 Glacial & Pleistocene Geology	3 cr
89.352 Sedimentation & Stratigraphy	3 cr
89.354 Sedimentation & Stratigraphy Lab	1 cr
Geoscience electives	6 cr

Select two of the following:

89.452 Advanced Geochemistry	3 cr
89.356 Applied Geophysics	3 cr
89.524 Regional Hydrogeology	3 cr

C. Supporting Sciences and Mathematics 37 cr

92.131 Calculus I	4 cr
92.132 Calculus II	4 cr
92.183 Intro to Statistics or	3 cr
92.386 Statistics for Sci & Eng	
95.201 Principles of Physics I	3 cr
96.103 Experimental General Physics I	1 cr
95.202 Principles of Physics II	3 cr
96.104 Experimental General Physics II	1 cr
84.121 Chemistry I	3 cr
84.123 Chemistry I Lab	1 cr
84.122 Chemistry II	3 cr
84.124 Chemistry II Lab	1 cr
81.111 Principles of Biology I	3 cr
81.113 Principles of Biology I Lab	2 cr

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81.112 Principles of Biology II	3 cr
81.114 Principles of Biology II Lab	2 cr

**III. Unrestricted Elective Courses
(2 credits)****IV. Minimum 120 Credit Requirement****Geoscience Minor**

A minor in Geoscience consists of 87.201 Principles of Earth & Environmental Systems I and 87.202 Principles of Earth & Environmental Systems II and four courses (plus any corequisite laboratories) from the following list. All course prerequisites and corequisites must be satisfied.

89.201 Principles of Geology	3 cr
89.203 Principles of Geology Lab	1 cr
89.301 Mineralogy & Crystallography	3 cr
89.303 Mineralogy & Crystallography Lab	1 cr
89.304 Igneous & Metamorphic Petrology	3 cr
89.306 Igneous & Metam. Petrology Lab	1 cr
89.314 Hydrogeology	3 cr
89.315 Environmental Geochemistry	4 cr
89.316 Geomorphology	3 cr
89.318 Geomorphology Lab	1 cr
89.322 Structural Geology	3 cr
89.324 Structural Geology Lab	1 cr
89.326 Glacial & Pleistocene Geology	3 cr
89.352 Sedimentation & Stratigraphy	3 cr
89.354 Sedimentation & Stratigraphy Lab	1 cr
89.356 Applied Geophysics	3 cr
89.452 Advanced Geochemistry	3 cr
89.514 Regional Hydrogeology	3 cr

**Sample Course of Study for
Atmospheric Science
Concentration****Freshman Year****Fall Semester**

42.101 College Writing I (Gen Ed)	3
84.121 Chemistry I	3
84.123 Chemistry I Lab	1
87.101 Env. Science Seminar	1
92.131 Calculus I	4
95.201 Principles of Physics I	3
96.103 Experimental Physics I	1
	16

Spring Semester

42.102 College Writing II (Gen Ed)	3
84.122 Chemistry II	3
84.124 Chemistry II Lab	1
85.102 Weather Forecasting Sem.	1
92.132 Calculus II	4
95.202 Principles of Physics II	3
96.104 Experimental Physics II	1
	16

Sophomore Year**Fall Semester**

87.201 Earth and Env. Systems I	4
92.231 Calculus III	4
92.263 FORTRAN Programming	3
Gen Ed Elective	3
	14

Spring Semester

87.202 Earth and Env. Systems II	4
92.234 Differential Equations	3
92.386 Statistics for Sci & Eng	3
Gen Ed Elective	3
Gen Ed Elective	3
	16

Junior Year**Fall Semester**

85.306 Env. Problem Solving	3
85.304 Methods in Meteorology I	3
Atmospheric Sci. Elective	3
89.315 Env. Geochemistry	4
Gen Ed Elective	3
	16

Spring Semester

85.302 Atmospheric Dynamics	3
85.305 Methods in Meteorology II	3
Atmospheric Sci. Elective	3
85.483 Solar-Terrestrial Rel.	3
Gen Ed Elective	3
	15

Senior Year**Fall Semester**

85.308 Fore. and Synoptic Tech I	3
85.403 Physical Meteorology	3
85.315 Adv. Atmos. Dynamics I	3
Atmospheric Sci. Elective	3
Gen Ed Elective	3
	15

Spring Semester

85.308 Fore. and Synoptic Tech. II	3
85.571 Air Pollution Phenomen.	3
85.316 Adv. Atmos. Dynamics II	3
Free Elective	3
	12

**Sample Course of Study for
Environmental Studies
Concentration****Freshman Year****Fall Semester**

42.101 College Writing I (Gen Ed)	3
84.121 Chemistry I	3
84.123 Chemistry I Lab	1
92.131 Calculus I	4
87.101 Env. Science Seminar	1
Gen Ed Elective	3
	15

Spring Semester

42.102 College Writing II (Gen Ed)	3
84.122 Chemistry II	3
84.124 Chemistry II Lab	1
92.132 Calculus II	4
87.102 Env. Problems Seminar	1
Gen Ed Elective	3
	15

Sophomore Year**Fall Semester**

87.201 Earth & Env. Systems I	4
95.201 Physics I	3
96.103 Exp. General Physics I	1
81.111 Principles of Biology I	3
81.113 Prin. of Biology I Lab	2
Mathematics Elective	3
	16

Spring Semester

87.202 Earth & Env. Systems II	4
95.202 Principles of Physics II	3
96.104 Exper. General Physics II	1
81.112 Principles of Biology II	3
81.114 Prin. of Biology II Lab	2
Gen Ed Elective	3
	16

Junior Year**Fall Semester**

89.315 Env. Geochemistry	4
Science Focus Elective	4
Hum/Soc Focus Elective	3
Gen Ed Elective	3
	14

Spring Semester

89.314 Hydrogeology	3
Science Focus Elective	3
Hum/Soc Focus Elective	3
Hum/Soc Focus Elective	3

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Gen Ed Elective	3
	15

Senior Year**Fall Semester**

81.315 Principles of Ecology	2
81.317 Principles of Ecology Lab	2
Science Focus Elective	4
Hum/Soc Focus Elective	3
Gen Ed Elective	3
	14

Spring Semester

87.406 Geographic Info. System	3
Science Focus Elective	3
Hum/Soc Focus Elective	3
Hum/Soc Focus Elective	3
Free Elective	3
	15

Sample Course of Study for Geoscience Concentration**Freshman Year****Fall Semester**

42.101 College Writing I (Gen Ed)	3
84.121 Chemistry I	3
84.123 Chemistry I Lab	1
92.131 Calculus I	4
87.101 Env. Science Seminar	1
Gen Ed Elective	3
	15

Spring Semester

42.102 College Writing II(Gen Ed)	3
84.122 Chemistry II	3
84.124 Chemistry II Lab	1
92.132 Calculus II	4
87.102 Env. Problems Seminar	1
Gen Ed Elective	3
	15

Sophomore Year**Fall Semester**

87.201 Earth & Envir. Systems I	4
95.201 Physics I	3
96.103 Exper. General Physics I	1
81.111 Principles of Biology I	3
81.113 Prin. of Biology I Lab	2
Mathematics Elective	3
	16

Spring Semester

87.202 Earth & Envir. Systems II	4
95.202 Principles of Physics II	3
96.104 Exper. General Physics II	1

81.112 Principles of Biology II	3
81.114 Prin. of Biology II Lab	2
Gen Ed Elective	3
	16

Junior Year**Fall Semester**

89.201 Principles of Geology	3
89.203 Principles of Geology Lab	1
89.301 Miner. & Crystallography	3
89.303 Mineralogy & Crystal. Lab	1
89.315 Envir. Geochemistry	4
Gen Ed Elective	3
	15

Spring Semester

89.304 Igneous & Metamor. Petro.	3
89.306 Igneous & Metamorphic Petrology Lab	1
89.314 Hydrogeology	3
89.316 Geomorphology	3
89.318 Geomorphology Lab	1
Geoscience Elective	3
Gen Ed Elective	3
	17

Senior Year**Fall Semester**

81.315 Principles of Ecology	2
81.317 Principles of Ecology Lab	2
89.322 Structural Geology	3
89.324 Structural Geology Lab	1
Geoscience Elective	3
Gen Ed Elective	3
	14

Spring Semester

87.406 Geographic Information System	3
89.326 Glacial & Pleistocene Geology	3
89.352 Sedimentation & Stratigraphy	3
89.354 Sedimentation & Strat. Lab	1
Free Elective	3
	13

Atmospheric Science Courses (Prefix:85)**85.102 Weather Forecasting Seminar**

Introduction to forecasting techniques including use of upper air observations and numerical forecast guidance. II(0,1)1

85.141 Weather & Climate

A general meteorology course for the non-science major. Topics include: atmospheric composition; solar radiation; temperature; moisture and condensation; relationship between air pressure and wind; weather patterns; severe weather; optical phenomena in the atmosphere; and the behavior and possible change of climate. I,II(3,0)3

85.301 Atmospheric Dynamics

Thermodynamics of dry air, water vapor and moist air. Hydrostatic equilibrium and its stability. Convection theory. Prerequisite: 87.202, 92.133, 95.202 I(3,0)3

85.304 Methods in Meteorology I

The application of vector analysis to dynamic meteorology. Three-dimensional divergence and vorticity, circulation, and solenoids. Selected ordinary and partial differential equations of fluid mechanics and their solutions. Spectral decomposition of hemispheric wave motion. Prerequisite: 87.202, 92.234 I(3,0)3

85.305 Methods in Meteorology II

Fundamentals of numerical weather prediction. Data analysis methods in meteorology using the techniques of curve fitting, correlation, and power spectrum analysis. Solution of stability problems. Prerequisites: 92.263 and 85.304 II(3,0)3

85.306 Environmental Problem Solving

The focus of the course is the development of problem-solving skills. Applications will be made to a wide range of environmental problems that resemble real-world situations. The emphasis in the course, however, will be on the thought process necessary to solve complex problems. Analysis of the problems will consider "hand-waving" to exact solutions, how and where to find the necessary governing equations and input, how and when to make approximations, and how to ensure that your answer is reasonable and, hopefully, correct. I(3,0)3

85.308 Forecasting and Synoptic Techniques I

Explores techniques of synoptic analysis including graphical subtraction, thickness analysis, isentropic analysis, streamlines and trajectories, divergence and vorticity. The use of a computer to perform these computations is explored through student

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projects. Prerequisite: 85.102, 87.202 I(1,4)3

85.309 Forecasting and Synoptic Techniques II

Explores three-dimensional structure and dynamics of mid-latitude storm systems; capabilities and limitations of the barotropic model; quasi-geostrophic model; and operational primitive equation models. Some mesoscale phenomena are covered as time permits including coastal cyclogenesis, thermal lows, and sea-breeze circulations. Prerequisite: 85.308 II(1,4)3

85.313 Physical Climatology

Atmospheric processes determining the climate; solar and terrestrial radiation, elevation and thermal properties of surfaces, atmospheric circulations and eddy conduction between the atmosphere and land or sea surfaces, heat and water balance of earth's surface and the atmosphere; hydrologic cycle; and climatic simulation models. Prerequisite: 87.202 or permission of instructor I(3,0)3

85.340 Tropical Meteorology

An introduction to the tropical atmosphere including tropical climatology, structure and dynamics of easterly waves, tropical cyclones and monsoonal circulations. Prerequisite: 87.202 I(3,0)3

85.350 Satellite and Radar Meteorology

Explores theory and applications of radar, satellites, and lidar. Use of satellite imagery as a forecasting aide; theory and use of satellite profiling; and application of conventional and Doppler radar to severe weather and short term forecasting. Use of lidar and other profiling techniques to determine vertical temperature structure and turbulence. Prerequisite: 87.202 II(3,0)3

85.360 Upper Atmosphere Meteorology

Explores structure of the stratosphere, mesosphere, and thermosphere. Chemistry and photochemistry of the upper atmosphere; formation and maintenance of ozone layer; and UVB absorption. General circulation of the stratosphere; quasi-biennial oscillation; and sudden stratospheric warming. Ionospheric structure, magnetosphere, and aurora borealis. Prerequisite: 87.202 II(3,0)3

85.403 Physical Meteorology

Explores solar and terrestrial radiation processes and the heat balance of the atmosphere; fundamentals of radiation theory; radiative transfer processes in the atmosphere; atmospheric condensation processes; and nucleation theory and the growth of water drops and ice crystals by condensation, sublimation and accretion. Prerequisite: 85.301 I(3,0)3

85.410 Advanced Forecasting

Advanced analysis techniques and their use as forecasting tools are explored in both manual and computer formats. Techniques include moisture advection; moist isentropic trajectories; boundary layer destabilization; and other state-of-the-art techniques. Application of techniques to small and mesoscale phenomena. Prerequisite: 87.202 II(1,4)3

85.415 Advanced Atmospheric Dynamics I

Explores dynamics of rotating fluids; potential vorticity equation; atmospheric discontinuities; and perturbation theory of wave motions. Sutcliffe development and elements of numerical weather prediction. Prerequisite: 85.302 I(3,0)3

85.416 Advanced Atmospheric Dynamics II

Explores stability of atmospheric circulations; barotropic and baroclinic models; and atmospheric energy transformations. General circulation theory. Prerequisite: 85.415 II(3,0)3

85.483 Solar-Terrestrial Relations

This course presents an overview of solar-terrestrial relations with emphasis on morphology, related electromagnetic theories and a study of quiescent and disturbed states. Topics include solar physics, interplanetary medium, the geomagnetic field and magnetospheric physics. Each student will select one topic for independent study to assess observational techniques or relevant theories. II(3,0)3

85.491 Directed Study in Atmospheric Science

Students, through regular and frequent consultation with the instructor, undertake independent study of a particular area of meteorology. Prerequisite: permission of instructor I,II(Arr)1-3

85.495 Honor's Research in Atmospheric Science

An individual or team research project car-

ried out by qualified students with the approval of, and supervision by, a faculty member. Prerequisite: consent of supervising faculty member I,II(Arr)3-6

85.496 Practicum Experience

A program of on-campus and/or off-campus experiences developed by the student in consultation with a faculty member and, when appropriate, a member of the staff of an off-campus firm. May be repeated to a maximum of six credits. The practicum may not be substituted for a non-elective course in the major. Prerequisite: permission of the Department Chair I,II(Arr)1-3

85.523 Air Pollution Control

This course describes air pollutants, their characterization, ambient concentrations, effects on human health and the ecology, and the environmental laws and regulations that set standards on emission rates and ambient concentrations. The basics of air pollutant dispersion and transport are also covered. The main focus of the course is on emission control technologies for particulate matter, carbon monoxide, sulfur oxides, nitrogen oxides, organic and inorganic toxic pollutants. The following technologies are discussed: cyclones, scrubbers, electrostatic precipitators, baghouses, adsorption, absorption and incineration. The automobile and its emission control are reviewed. Alternative methods are also discussed, such as fuel substitution, conservation and efficiency improvement. I(3,0)3

85.571 Air Pollution Phenomenology

The course centers on transport, dispersion and transformation of air pollutants in the atmosphere. Atmospheric structure and dynamics are reviewed. The atmospheric dispersion equation is developed for instantaneous and steady state releases of pollutants, including the Gaussian Plume Equation for point, line and area sources. The sources and transport of particulate matter are discussed, including haze and visibility impairment. Other topics are photo-oxidants (ozone), acid deposition, stratospheric ozone depletion and the greenhouse effect. II(3,0)3

Environmental Studies Courses (Prefix: 87)

87.101 Intro to Environmental Science

A survey of the field of environmental sci-

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ence, curriculum options, and career opportunities. Presentations by members of the department and guest speakers. Only for Environmental Science majors. I(1,0)1

87.102 Environmental Problems Seminar

A survey of environmental problems and issues. Topics include air, water, and noise pollution; solid and liquid waste disposal; and the social, political, and economic implications of these issues. Readings, discussions, guest speakers, and field trips. Only for Environmental Science majors. II(1,0)1

87.104 Foundations of Conservation and Environmental Concern

A study of the evolution of American environmental perception. Topics include a review of the changes in the philosophical framework defining human relationships to federal land and water policy, as well as the contributions of naturalists, scientists and laymen toward establishing a concern for environmental quality. I,II(3,0)3

87.111 Environmental Science

A survey course for non-science majors. Topics include ecosystems, population growth, production and distribution of food, pest control, agricultural resources, the water cycle, energy resources, air and water pollution, hazardous chemicals, recycling, economic and legal aspects of environmental issues, and the question of sustainability. I,II(2,2)3

87.115 Astronomy

An introduction to the study of astronomy including historical development, instruments, solar system dynamics, planetary evolution, stellar systems and stellar evolution. I,II(3,0)3

87.117 Astronomy Laboratory

Intended to develop a deeper understanding of astronomy through an exposure to the methods and materials used in astronomical analysis. Corequisite: 87.115 I,II(0,2)1

87.201 Principles of Earth & Environmental Systems I

An integrated study of the interactions between the lithosphere, hydrosphere, atmosphere, and biosphere. Emphasis will

be placed on the physical and biological principles which underlie and control these interactions, pollution, geologic hazards, climate change, and social and political aspects which govern our relationship with the natural environment. Only for Environmental Science majors. Prerequisite or Corequisite: one semester college chemistry, one semester college physics. I(2,2)3

87.202 Principles of Earth & Environmental Systems II

A continuation of Principles of Earth & Environmental Systems. Only for Environmental Science majors. Prerequisite: 87.201. Prerequisite or Corequisite: two semesters college chemistry, two semesters college physics II(2,2)3

87.326 Introduction to GIS for Sector Applications

This course will introduce the basic Geographic Information Systems tools and functions with applications tailored to a specific discipline. When this course is offered the orientation for that semester will appear in the descriptions as "Introduction to GIS for Sector Applications". I,II(3,0)3

87.403 Introduction to GIS using IDRISI

This course introduces the methods of Geographic Information Systems using the IDRISI GIS software platform. IDRISI is a robust raster based GIS package particularly suited for applications where remote sensing images constitute the dominant data source. I,II(3,0)3

87.406 Geographic Information Systems

This course will cover the elements of a Geographic Information System commonly found in basic and mid-level GIS applications. This will include file organization, data entry including digitizing and image registration, geocoding, Structured Query Language (SQL) applications, map algebra and statistical model functions, as well as general issues related to GIS implementation and GIS product presentation in organizational settings. II(3,0)3

87.491 Directed Study in Environmental Studies

The student, through regular and frequent consultation with the instructor, undertakes independent study of a particular

area of environmental science. Prerequisite: permission of instructor I,II(Arr) 1-3

87.495 Honors Research in Environmental Studies

An independent scientific research project carried out by a qualified senior under the supervision of a faculty member. Prerequisite: consent of supervising faculty member I,II(Arr)3-6

87.496 Practicum Experience

A program of on-campus and/or off-campus experiences developed by the student in consultation with a faculty member from the Department and, when appropriate, a member of the staff of an off-campus firm. May be repeated to a maximum of six credits. The practicum may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson I,II(Arr)1-3

**Geography Courses
(Prefix: 88)****88.101 World and Regional Geography**

A survey of the significance, characteristics, and principal geographic problems of the world's major regions. I(3,0)3

88.102 Geography of the U. S. and Canada

A regional geography of North America with emphasis on the human and physical characteristics of different geographic regions and their interaction with each other. II(3,0)3

**Geoscience Courses
(Prefix: 89)****89.101 General Geology**

A survey of earth structure and processes covering earth materials, crustal dynamics, landform development, and earth history and the evolution of life. Designed for the general student. I,II(3,0)3

89.103 General Geology Lab

An introduction to the identification of rocks and minerals and the interpretation of topographic and geologic maps. Field trips as appropriate. Corequisite: 89.101 I,II(0,2)1

89.111 Ocean Science

A study of the biology, chemistry, geology

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and physics of the oceans, oceanic pollution, coastal processes, and the role of the oceans in weather and climate. Designed for the general student. I,II(2,2)3

89.201 Principles of Geology

A continuation of Principles of Earth & Environmental Systems for students in the Geoscience Concentration. Emphasis will be on historical geology, fossils, development of the rock record, surficial processes, geologic hazards, and the interpretation of spatial data. Prerequisite: 87.202 Corequisite: 89.203. I(3,0)3

89.203 Principles of Geology Laboratory

Corequisite: 89.201 I(0,3)1

89.301 Mineralogy & Crystallography

This course will introduce the concepts of crystallography necessary to prepare the student to use the analytical equipment of Optical Mineralogy and X-ray Crystallography. It also contains topics on the physical and chemistry of minerals aimed at improving the student's ability to identify mineral samples and understand chemical classifications. A significant portion of the course will be devoted to an introduction to optical methods using oil immersion and thin section techniques. I(3,0)3

89.303 Mineralogy & Crystallography Lab

corequisite: 89.301 I(0,2)1

89.304 Igneous & Metamorphic Petrology

The origin and evolution of igneous and metamorphic rocks. Emphasis will be on physical and chemical processes; magma transport and crystallization, phase equilibria, development of metamorphic facies, open and closed system behavior, and the development of metamorphic fabric. Prerequisite: 89.301 II(3,0)3

89.306 Igneous & Metamorphic Petrology Lab

Identification and classification of igneous and metamorphic rocks. Emphasis is on thin section identification and use of rock textures and compositions as guides to petrogenesis. Prerequisite: 89.303. Corequisite: 89.304 II(0,3)1

89.314 Hydrogeology

A study of the distribution and movement of water on the earth's surface with emphasis on the geologic effects. Topics include: application of statistics to streams,

ground-water flow nets, and well hydraulics. Prerequisite: 92.131 II(3,0)3

89.315 Environmental Geochemistry

Application of geochemical principles to environmental problems including air pollution and atmospheric processes, climate change, water chemistry and water-rock interactions, and the transport and dispersal of organic and inorganic pollutants. Prerequisite: 87.202 or permission of instructor I(2,2)4

89.316 Geomorphology

A study of the physical and chemical processes at work on the earth's surface which result in the formation and development of surface features. Emphasis is placed on the mechanics of erosion (water, wind, ice, and waves) and the morphology and spatial distribution of the resultant landforms. Prerequisite: 89.201. Corequisite: 89.318 II(3,0)3

89.318 Geomorphology Lab

Corequisite: 89.316 II(0,2)1

89.322 Structural Geology

An analysis of crustal deformation through detailed study of geologic structures with emphasis upon the response of geologic materials to stress and strain. Field techniques, tectonic principles, and geometrical analysis are employed. Prerequisite: one semester of physics. Corequisite: 89.324 I(3,0)3

89.324 Structural Geology Lab

Corequisite: 89.322 I(0,2)1

89.326 Glacial & Pleistocene Geology

A survey and interpretation of the erosional and depositional effects of glaciation with emphasis on the New England area. Topics include glaciology, glacial geology, and Pleistocene stratigraphy. Prerequisite: 89.316 I,II(3,0)3

89.352 Sedimentation & Stratigraphy

Principles and processes of sedimentation: erosion, mechanics of transport, diagenesis and lithification, models for sedimentary environments. Development of the stratigraphic record, relative and absolute time, and seismic stratigraphy. Prerequisite: 89.201. Corequisite: 89.354. II(3,0)3

89.354 Sedimentation & Stratigraphy Lab

Determination of mass properties of sediments with emphasis on mechanical and

statistical analysis, identification and description of sedimentary rocks, facies models and stratigraphic cross-sections. Corequisite: 89.352 II(0,2)1

89.452 Advanced Geochemistry

Application of chemical principles to geological and environmental problems. Topics include abundance and distribution of elements in the earth, crystal chemistry, stable and radiogenic isotopes, radiogenic dating, isotopic and elemental tracers, water-rock interactions. Prerequisite: one year of college chemistry I,II(3,0)3

89.456 Applied Geophysics

Application of geophysics to problems in geology and environmental science. Principles and techniques of gravity, magnetic, electrical, and seismic methods. Field projects and surveys. Prerequisite: one year of college physics I,II(2,2)3

89.491 Directed Study In Geoscience

The student, through regular and frequent consultation with the instructor, undertakes independent study of a particular area of the geosciences. Prerequisite: permission of instructor I,II(Arr)1-3

89.495 Honors Research in Geoscience

An independent scientific research project carried out by a qualified senior under the supervision of a faculty member. Prerequisite: consent of supervising faculty member I,II(Arr)3-6

89.524 Regional Hydrogeology

Concentrating on the storage and steady state flow of ground water at a basin-wide scale, the course studies flow nets, fluid potential, and numerical modeling of flow controlled by basin geometry and geology; water movement in the zone of aeration, the interaction of ground-water with surface water, the transport and dispersion of contaminants, and the use of modeling for ground-water management. Prerequisite: permission of the instructor I,II(3,0)3

Department of Economics

Ernesto F. Sanz, Chairperson

Professors: Albert Cederlund, Thomas Macbeth, Carol McDonough, Ernesto Sanz, Balbir Sihag

Associate Professors: Michael Carter, George Dery, Supriya Lahiri, Paul E. Snoonian

Affiliated Faculty: Jean Pyle

Economics Major

(Bachelor of Arts)

Economics as a discipline is concerned with the principles underlying the production and exchange of products and services. The study of economics stems from the scarcity of resources and the limitless nature of our demands for products and services. Societies must therefore choose the goods and services that will be produced from among the larger range of production possibilities. Economics develops the principles and concepts that follow from this fact of scarcity and applies them to the analysis of various aspects of human activity.

The Economics major may choose one of three "tracks" of study, or select an array of six upper level courses of his/her own choice. The selected tracks are the following:

General Economics Track

International Economics Track

Environmental Economics & Urban Economics Track

All Economics majors must take the following courses:

- 49.201 Economics I
- 49.202 Economics II
- 49.211 Statistics for Business & Economics I
- 49.212 Statistics for Business & Economics II
- 49.303 Microeconomic Theory
- 49.304 Macroeconomic Theory

Introductory courses in the Economics Department (49.201 and 49.202), which may be taken in either order, survey economic problems, policies, and theory.

Required courses in microeconomic and macroeconomic theory and in statistics provide a deeper analytical foundation and the necessary quantitative tools. In addition to these required courses, the student chooses economics electives as specified by the track he/she has chosen. Those electives provide students with opportunities to explore subject areas that are of personal interest and consistent with career objectives.

Besides these six courses, a major in Economics must choose one of two options: proficiency in a modern language, or proficiency in quantitative skills. Students who choose the International Economics Track must take the modern language option (Consult the "University Academic Policies: Language Requirement" section for details).

The option in quantitative skills requires the fulfillment of the following:

1. at least two courses from the following Mathematics Department offerings

- 92.121 Pre-Calculus Math
- 92.122 Differential Calculus
- 92.201 Integral Calculus

2. at least two of the following quantitative economics courses:

- 49.211 Statistics I
- 49.212 Statistics II
- 49.312 Managerial Economics
- 49.407 Econometrics.

General Economics Track

This track is designed to provide the student with a strong and flexible background in economic theory and some important applications of that theory. In addition to the six required courses, the student chooses six additional economics courses, of which at least two must be at the 400 level. The mathematics requirement for this track is Pre-Calculus Math (92.121) and Calculus (92.122).

International Economics Track.

This track is designed to acquaint students with international economic theory and policy issues, as well as expertise in the language and culture of a particular area of the world. Three major areas of specialization are offered: East Asia, Latin America, and Europe. The student selects one of

these areas and chooses courses in languages, history, political science, etc., related to this area. In addition, it is strongly recommended that the student spend a semester abroad in the area he or she chooses.

This track consists of eleven economics courses, as well as several courses from other departments, as described below. In economics, in addition to the six required courses, students take:

- 49.403 International Trade Theory and
- 49.307 Government & Business; plus two international economics electives from the following:
- 49.320 Comparative Economics Systems
- 49.310 Economics of Less Developed Countries
- 49.322 Japan in the Global Economy; and one free economics elective.

The mathematics requirement for this track is Pre-Calculus Math (92.121)

Students are also required to take World and Regional Geography (88.101), Introduction to International Relations (46.121), and one course each in the History and Political Science of the area they choose.

Environmental Economics & Urban Economics Track

This track is designed to acquaint the student with the applications of economic theory to important public policy issues concerning the effect of economic activity on the environment, energy use, and the quality of life in urban areas. It consists of twelve economics courses, as well as two courses in the sciences, as described below. In economics, in addition to the six required courses and two free economics electives, the student chooses four courses from the following:

- 49.305 Women, Minorities & Immigrants in the Labor Force
- 49.306 Urban Economics
- 49.315 Introduction to Environmental Economics
- 49.319 Public Finance
- 49.328 The Economics of Energy and the Environment

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49.329 The Economics of Ecological Preservation

*Consult the Academic Policy section of this catalogue for the General Education requirements in the sciences.

Minor in Economics

Eighteen (18) credits hours are needed for a minor in Economics. All minors must take Economics I (49.201) and Economics II (49.202). Four additional economics electives are required, two of which must be at the 300 level or 400 level.

Within this general framework, a wide variety of options is open to students who minor in economics. Courses can be taken to emphasize a particular area like international, quantitative or environmental economics, or a series of courses can be chosen from different areas to strengthen or complement the student's major discipline. Some of these courses are required in many MBA programs and some schools waive them if they have been taken at the undergraduate level.

The following are some of the courses from which a minor can choose grouped by general areas:

General Economics:

- 49.302 Labor Economics
- 49.303 Microeconomic Theory
- 49.304 Macroeconomic Theory
- 49.305 Women, Minorities and Immigrants
- 49.306 Urban Economics
- 49.318 Financial Markets and Monetary Policy
- 49.319 Public Finance
- 49.325 U.S. Economic History

Environmental Economics:

- 49.315 Introduction to Environmental Economics
- 49.328 The Economics of Energy and the Environment
- 49.329 The Economics of Ecological Preservation

International Economics:

- 49.310 Economics of Less Developed Nations

- 49.320 Comparative Economic Systems
- 49.322 Japan in the Global Economy
- 49.323 The Economics of East Asia
- 49.335 International Political Economy
- 49.403 International Trade Theory

Quantitative Economics:

- 49.211 Statistics for Business and Economics I
- 49.212 Statistics for Business and Economics II
- 49.312 Managerial Economics
- 49.407 Econometrics

Sample Courses of Study for Economics

For students entering in Fall 1993

and subsequently

Track I: General Economics**Freshman Year****Fall Semester**

- 42.101 College Writing I (Gen Ed) 3
- 49.201 Economics I 3
- 92.121 Precalculus 3
- Beginning Language I 3
- Beh & Soc Studies (Gen Ed) 3

Spring Semester

- 42.102 College Writing II (Gen Ed) 3
- 49.202 Economics II 3
- 92.122 Differential Calculus 3
- Beginning Language II 3
- Science* (Gen Ed) 3

Sophomore Year**Fall Semester**

- 49.211 Statistics I 3
- 92.201 Integral Calculus 3
- Intermediate Language I 3
- Science* (Gen Ed) 3
- Beh & Soc Studies (Gen Ed) 3

Spring Semester

- 49.212 Statistics II 3
- Historical Studies (Gen Ed) 3
- Intermediate Language II 3

- Literature (Gen Ed) 3
- Free Elective 3

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Junior Year**Fall Semester**

- 49.301 Microeconomic Theory 3
- 49. Economics Elective 3
- 49. Economics Elective 3
- Aesthetics (Gen Ed) 3
- Free Elective 3

15

Spring Semester

- 49.302 Macroeconomic Theory 3
- 49. Economics Elective 3
- 49. Economics Elective 3
- Values, C & C 3
- Free Elective 3

15

Senior Year**Fall Semester**

- 49.4 Economics Elective 3
- Science* (Gen Ed) 3
- Free Elective 3
- Free Elective 3
- Free Elective 3

15

Spring Semester

- 49.4 Economics Elective 3
- Free Elective 3
- Free Elective 3
- Free Elective 3
- Free Elective 3

15

Track II: International Economics**Freshman Year****Fall Semester**

- 42.101 College Writing I (Gen Ed) 3
- 92.121 Precalculus 3
- 49.201 Economics I 3
- Beginning Language I 3
- Beh & Soc Studies (Gen Ed) 3

15

Spring Semester

- 42.102 College Writing II (Gen Ed) 3
- 49.202 Economics II 3
- Beginning Language II 3
- Science* (Gen Ed) 3
- Free Elective 3

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*Sophomore Year***Fall Semester**

49.301	Microeconomic Theory	3
88.101	World & Reg Geog (Beh & SS)	3
	Historical Studies (Gen Ed)	3
	Intermediate Language I	3
	Free Elective	3
		15

Spring Semester

49.302	Macroeconomic Theory	3
46.121	Intro to Int'l Relations	3
	Science* (Gen Ed)	3
	Intermediate Language II	3
	Free Elective	3
		15

*Junior Year***Fall Semester**

49.211	Statistics I	3
49.403	International Trade	3
	Science* (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

49.212	Statistics II	3
49.	Int'l Economics Elective	3
	Values, C & C (Gen Ed)	3
	Literature (Gen Ed)	3
	Free Elective	3
		15

*Senior Year***Fall Semester**

49.	Economics Elective	3
49.	Int'l Economics Elective	3
	Aesthetics (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

49.307	Government & Business	3
41.366	International Law	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

*Consult the Academic Policies section of this catalogue for the General Education requirements in the sciences.

Track III : Environmental & Urban Economics*Freshman Year***Fall Semester**

42.101	College Writing I (Gen Ed)	3
49.201	Economics I	3
92.121	Precalculus	3
	Beginning Language I	3
	Beh & Soc Studies (Gen Ed)	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
49.202	Economics II	3
92.122	Differential Calculus	3
	Beginning Language II	3
	Science* (Gen Ed)	3
		15

*Sophomore Year***Fall Semester**

49.211	Statistics I	3
92.201	Integral Calculus	3
	Intermediate Language I	3
	Science* (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

49.212	Statistics II	3
	Beh & Soc Studies (Gen Ed)	3
	Intermediate Language II	3
	Values, C & C (Gen Ed)	3
	Free Elective	3
		15

*Junior Year***Fall Semester**

49.301	Microeconomic Theory	3
49.	Economics Elective	3
49.	Economics Elective	3
	Historical Studies (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

49.302	Macroeconomic Theory	3
49.	Economics Elective	3
49.	Economics Elective	3
	Aesthetics (Gen Ed)	3
	Free Elective	3
		15

*Senior Year***Fall Semester**

49.	Economics Elective	3
	Literature (Gen Ed)	3
	Science* (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

49.	Economics Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

84.101	Applied Chemistry for the Non-scientist	
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93.141	Weather & Climate	
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*Consult the Academic Policies section of this catalogue for the General Education requirements in the sciences.

**Economics Courses
(Prefix: 49)****49.101 The Economics of Social Issues**

The course addresses the economic base of social issues and introduces students to the principles regulating the mix of goods produced; the methods of production chosen; and the distribution of incomes generated within profit driven, market-based economic systems. 3 cr

49.201 Economics I

A study of the principles of production and exchange. An introduction to demand, supply, pricing, and output under alternative market structures. Derived demand and resource markets are introduced. 3 cr

49.202 Economics II

A study of the principles governing the level of national income and employment. Examination of the commercial banking system, monetary and fiscal policy, the international economy, and alternative economic systems. Prerequisite: 49.201 3 cr

49.211 Statistics for Business and Economics I

Descriptive statistics, sophisticated counting techniques and other components of

probability, simple random variables and their distribution, bivariate functions, sampling theory properties of estimators. Prerequisite: 92.122 or equivalent 3 cr

49.212 Statistics for Business and Economics II

Interval estimation, hypothesis testing, analysis of variance, applied regression theory, correlation analysis, and other selected topics. Prerequisite: 49.211 3 cr

49.301 Computer Applications of Microeconomics

The course develops skills in the use of the internet, spreadsheets and word processors in order to analyze problems in applied microeconomics. Market analysis of individual companies and industry studies provide the analytical framework of the course. Prerequisite 49.201 3 cr

49.302 Labor Economics

The effect of American capitalism on the position of labor. The rise of union organization and the factors in its growth. Trends in the labor force, money and real wages, wage problems and wage differentials, problems of hours and working conditions, and causes and remedies for unemployment. Prerequisites: 49.201 and 49.202. 3 cr

49.303 Microeconomic Theory

An advanced examination of price and production theory and the theory of the consumer and the firm. Prerequisites: 49.201, 49.202. 3 cr

49.304 Macroeconomic Theory

An analysis of Keynesian and post-Keynesian theory. National income accounts, monetary and fiscal policy, and econometric models. Prerequisites: 49.201, 49.202. 3 cr

49.305 Women, Minorities and Immigrants in the Labor Force: Theoretical and Policy Issues

Use of economic theory to explain the subordinate roles these groups have had in the U.S. labor force. Given their importance for future growth, we examine ways to incorporate them more fully including controversial public policy issues such as affirmative action, immigration reform, childcare, parental leave and comparable worth. Prerequisite: 49.201 or 49.202. 3 cr

49.306 Urban Economics

An introduction to urban economics. Analysis of intrametropolitan spatial relationships including location, land use, and housing markets. Prerequisite: 49.201 or 49.202. 3 cr

49.307 Government & Business

An examination of various governmental and nongovernmental controls on business and nonprofit organizations. Emphasis is on the impact of laws, court interpretations, economic theories, social and political philosophies, and ethical consideration on these organizations. Students have an opportunity to examine business decisions which involve questions of value and choice. Prerequisites: 49.201, 49.202. 3 cr

49.308 Case Studies in Government Regulation

Provides students with cases involving application of economic analysis including pollution regulation and industry-specific regulation. Students are expected to write reports on topics assigned for research in this course. Prerequisite: 49.307. 3 cr

49.310 Economics of Less Developed Countries

Formulation of an approach to development that includes the role of goals (growth, equity), sectors (agriculture, industry, services), resources (labor, capital, technology), government, international (trade, investment, debt), and political and socio-cultural factors. Examines 'success' in a few Asian countries, failure in most of Africa, and crisis in South America emphasizing current controversies. Prerequisite: 49.201 or 49.202. 3 cr

49.312 Managerial Economics

Economic theory and statistical methods applied to business decision making. Estimation of demand, production, cost functions and accompanying elasticity estimates, pricing and output decisions, value maximization problems, and capital budgeting. Prerequisites: 49.201, 49.202, 49.211, 49.212. 3 cr

49.315 Introduction to Environmental Economics

Environmental problems caused by externalities and market failure are examined. An analysis of pollution controls such as voluntary programs, direct controls, taxes on emissions, and other

monetary incentives are evaluated. Environmental problems in planned economies are also discussed. Prerequisite: 49.201. 3 cr

49.316 Business & Economic Forecasting

Develops the fundamentals of forecasting for managerial decision making. Topics covered are data collection, review of basic statistical concepts, and computerized forecasting techniques. The forecasting models developed include averaging, smoothing, time series, correlation, and regression. Prerequisites: 49.201, 49.202, 49.211, 49.212. 3 cr

49.317 Capital Markets

A study of the principles of portfolio theory and the pricing of financial instrument in capital markets. Use of derivative markets to implement arbitrage, hedging and risk management strategies. Extensive background institutional detail on stock, bond, mortgage-backed, currency, futures and options market. 3 cr

49.318 Financial Markets and Monetary Policy

The economics of financial intermediation and central bank monetary policy. Evaluation of global financial markets, financial deregulation, bank failures and financial stability, determinants of the level and term structure of interest rates, and the impacts of monetary policy changes on overall levels of output, employment and prices are topics analyzed in this course. Prerequisites: 49.201, 49.202. 3 cr

49.319 Public Finance

The economics of the public sector. Principles of public expenditure, taxation, and the public debt applied to federal state, and local governments. Prerequisites: 49.201 or 49.202. 3 cr

49.320 Comparative Economic Systems

Analysis of free-market and planned economies in theory and practice. Emphasis on the United States, Japan, EC countries and the former Soviet Block nations. Prerequisite: 49.201 or 49.202. 3 cr

49.322 Japan in the Global Economy

A review of the postwar Japanese Economy and its legacy from the Tokugawa, Meiji and Taisho periods. An analysis of economic and management

policies to explain postwar Japan's high rate of economic growth. A review of fiscal, monetary and industrial policies; labor, management, and government structures; and external economic relations. Prerequisite: 49.202. 3 cr

49.323 The Economies of East Asia

The study of the high performing Asian economies. Economic growth is related to public policy, macroeconomic stability, equity and its institutional framework, export promotion models, human capital formation, savings and investment policies, use of market mechanism in allocating resources. 3 cr

49.325 U.S. Economic History

The evolution of institutions and their functions, and sources of economic development. The contributions of railroads, agricultural population growth, immigration, capital formation and technological progress to economic development. Other areas addressed: rapid industrialization and antitrust laws; evolution of financial institutions, the creation of the Federal Reserve System, crash of 1929, the depression of the 1930s, the New Deal and various banking acts; the labor movement; the growth of international trade. Prerequisite: 49.201 or 49.202. 3 cr

49.326 History of Economic Thought

The rise of classical growth and value theories. The evolution of neoclassical theories of price and distribution, and the development of welfare criteria. A comparison of Keynesian and classical macroeconomic theory. The role of economic analysis of the post-Keynesian world. Prerequisites: 49.303 and 49.304 or permission of instructor. 3 cr

49.328 The Economics of Energy and the Environment

Economic and policy issues related to the use of energy and the environment. Topics include: Energy demand analysis; Inter factor and inter fuel substitution; Supply uncertainty problems; Energy pricing; Energy/Environment/Macro-economic linkages; intertemporal allocations; trade-off issues between growth and stable and cleaner environment; Pollution potential of major energy resources; Greenhouse effect; Economics of pollution control and energy policy; Energy conservation and efficiency; Scarcity and the limits to growth. Prerequisite: 49.201. 3 cr

49.329 The Economics of Ecological Preservation

Survey of static and dynamic social welfare theory as applied to environmental preservation issues. Complications introduced by non-reproducible goods, irreversible processes, and incompletely specified property rights. Limitations of unregulated market price signals in achieving either efficient or sustainable intertemporal resource allocations. Role of government in creating efficient market structures. Detailed applications to the problem areas of forestry management, maintenance of biological diversity, waste disposal, global warming. Prerequisite: 49.201. Recommended: 49.315. 3 cr

49.335 International Political Economy

Explores current international issues (flows of trade, money, and debt; multinational corporations and workers; regional integration; environmental concerns) within the context of historical trends and different theoretical approaches. 3 cr

49.337 Technological Change and Economic Growth

The study of economic growth through improvements in the usage of capital, labor, energy, and other resources. An examination of classical capital accumulation models including Karl Marx, Neoclassical Growth, and Schumpeter's theory of unstable growth. Discussion of technological diffusion, innovation, and invention. Prerequisites: 49.201 or 49.202, 49.212. 3 cr

49.345 Economics of the Health Industry

A review of the major developments in the health care industry during the last forty years. The anatomy and workings of health care industry: the hospitals, the physicians, the insurance companies, the HMOs, the pharmaceutical companies, the consumers and the Government. The problems of moral hazard and adverse selection. Government regulation of health care industry and Government-provided health care programs. International comparisons of health care systems. Critically examining the various proposals to reform the health care industry: the cost, the quality and the universality of health care. Prerequisite: 49.202. 3 cr

49.403 International Trade Theory

The classical and modern theories. International payments, exchange and trade controls, and international trade policy determinants. Prerequisites: 49.201, 49.202. 3 cr

49.407 Econometrics

Review of the basic assumptions, estimation with deficient data, multiple regression, formulation and estimations of special models, the generalized linear regression model and its applications, and simultaneous equation system. Prerequisites: 49.201, 49.202, 49.211, 49.212 or permission of instructor. 3 cr

49.436 Financial Economics

Topics include risk aversion and stochastic dominance, the mathematics of portfolio frontiers, capital asset pricing, pricing of options, equilibrium valuation and arbitrage valuation of multiperiod securities. Econometric issues in capital asset pricing. Prerequisites: 49.201, 49.202, 49.212 or permission of chairperson. 3 cr

49.496 Internship in Economics

The course is restricted to majors in Economics. The objective of the practicum is to obtain experience in the application of economic knowledge and analysis. By working in preapproved environments students can enhance the applied knowledge of economic principles underlying the operation of public and private institutions. The practicum cannot replace the required courses of the major but three credits may be applied to the fulfillment of a 400 level economics elective. Another three credits can be earned in a subsequent semester as an additional economics elective. The grading of the course is "satisfactory" or "unsatisfactory." Prerequisite: permission and supervision of the chairperson or his/her designee is needed.

49.499 Directed Studies

A course to permit the advanced student to do research in topics of special interest in economics under faculty supervision. This course also may be utilized to offer topics to individual students where there are insufficient number of registrants for a regular class. Restricted to Economics majors. Prerequisite: permission of the chairperson. 3 cr

Department of English

49.615 Environmental and Natural Resource Economics

The development of concepts and methods of economic analysis with a view toward their application for preserving the environment. An analysis of economic growth and the usage of depletable resources. Appraisal of quantitative methods for measuring environmental damage and the cost of abatement. Prerequisite: graduate student or permission of chairperson. 3 cr

Department of English

William H. Roberts, Chairperson

Professors: William C. Burto (Emeritus), Arthur Friedman (Emeritus), William Hersey, Mary Kramer, Clifford Lewis, Martha McGowan, Barbara Langell Miliaras, Gerard O'Connor (Emeritus), Judith Pastore (Emerita), William Roberts, Robert Stein, Roger Wiehe (Emeritus), Joseph Zaitchik, Charles E. Ziavras (Emeritus)

Associate Professors: Donald Berry, Andrea Corbett, William Coughlin, John McCaffrey, Melissa Pennell, Charles Ryan, Francesca Tillona

Assistant Professors: Arthur Dabilis, Tara Elyssa, Hilary Holladay, Jeannie Judge, Robert Kachur, Marlowe Miller

The English Department offers a major in English leading to the Bachelor of Arts Degree. The Department offers a general minor in English and specialized minors in English literature, American literature, drama, writing, and journalism/communications.

The English Major

(30-45 credits)

The English Department offers two separate concentrations: one in literature and the other in writing. Both concentrations require an intermediate proficiency in a foreign language and also the following nine courses:

- 42.201 Great Books of Antiquity
- 42.291 History of English Lit I
- 42.292 History of English Lit II
- 42.293 History of English Lit III
- 42.294 History of American Lit I
- 42.295 History of American Lit II
- 42.296 History of American Lit III
- 42.307 History and Development of the English Language
- or
- 42.308 Analysis of Modern English
- 42.423 Shakespeare I
- or
- 42.424 Shakespeare II

In addition, both concentrations require at least nine departmental credits at the 300 level and limit 200 level departmental credits to six.

The Literature Concentration

The Department recommends 300 and 400 level courses from the following categories:

Medieval and Renaissance
Restoration and Neoclassical
Romantic and Victorian
Twentieth Century

The Writing Concentration

The writing concentration requires:

- 42.227 Essay Writing for English Majors
- 42.496 Practicum

Writing concentrators must also choose at least three courses from the following list:

- 42.300 Intro to Journalism
- 42.301 Newswriting
- 42.302 Creative Writing: Fiction
- 42.303 Creative Writing: Poetry
- 42.305 Reviewing the Arts
- 42.306 Professional Writing
- 42.309 Argum & Research Skills
- 42.320 Personal & Reflective Writing
- 42.323 Writing About People
- 42.387 Editing & Publishing Techniques
- 42.390 Tech and Sci Writing
- 42.391 Business Communication
- 42.402 Topics in Writing

Students must arrange for their practicum experience during the pre-registration period with the Director of the Writing Practicum.

Requirements for Minors

Every English Department minor is open to students enrolled in any undergraduate college at the University.

American Literature

A minor in American Literature consists of 18-24 credits selected from the following list; at least six credits must be taken at the 300 level or above:

- 42.291 History of English Lit I or
- 42.292 History of English Lit II or
- 42.293 History of English Lit III
- 42.294 History of American Lit I
- 42.295 History of American Lit II
- 42.296 History of American Lit III
- Electives in American Lit

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Department of English

Drama

A minor in Drama consists of 18-24 credits selected from the following list; at least six credits must be taken at the 300 level or above:

- 42.218 Comedy
- 42.219 Tragedy
- 42.423 Shakespeare I or
- 42.424 Shakespeare II
- Electives in drama
- Electives in stagecraft or acting

General English Minor

A minor in General English consists of 18-24 credits of coursework selected from the following list including six credits at the 300 level or above:

- 42.291 History of English Lit I
- 42.292 History of English Lit II
- 42.293 History of English Lit III
- 42.423 Shakespeare I or
- 42.424 Shakespeare II
- One course in American Lit
- Electives in English

English Literature

A minor in English Literature consists of 18-24 credits of coursework, including the following required courses; at least six credits must be taken at the 300 level or above:

- 42.291 History of English Lit I
- 42.292 History of English Lit II or
- 42.293 History of English Lit III
- 42.423 Shakespeare I or
- 42.424 Shakespeare II
- Electives in English Lit

Writing Minor in English

The writing minor, consists of 18-24 credits of coursework selected in accordance with the following specifications:

1. To be eligible, students must earn a grade of B or better in 42.227 Essay Writing for English Majors and they must successfully complete 42.308 Analysis of Modern English.
2. In addition, students must complete at least two writing courses from the following list; one of these courses must be a Writing Workshop:

- 42.300 Intro to Journalism
- 42.301 Newswriting
- 42.305 Reviewing the Arts
- 42.306 Professional Writing
- 42.309 Argumentation and Research Skills
- 42.320 Personal and Reflective Writing
- 42.387 Editing and Publishing
- 42.390 Advanced Technical and Scientific Writing
- 42.391 Business Communication
- 42.402 Topics in Writing
- 42.450 Writing Workshop

3. Students must select six to twelve credits from the English Department's general offerings.

Journalism Minor

Students in the journalism minor must take the following sequence of courses plus two additional writing courses from English Department offerings (18 credits):

- 42.227 Essay Writing for English Majors
- 42.300 Intro to Journalism
- 42.301 Newswriting and either
- 42.403 Special Topics: Feature Writing or
- 42.404 Special Topics: Freelance Journalism

Literature Concentration:

Suggested programs for a course of study.

Freshman Year

Fall Semester

- 42.101 College Writing I (Gen Ed) 3
- 92. Math* (Gen Ed) 3
- Beginning Language I 3
- Beh & Soc St (Gen Ed) 3
- Free or Minor Elective 3

15

Spring Semester

- 42.102 College Writing II (Gen Ed) 3
- Science* (Gen Ed) 3
- Beginning Language II 3
- Historical Studies (Gen Ed) 3

- 42.201 Great Books of Antiquity or
- Free or Minor Elective 3

15

Sophomore Year

Fall Semester

- 42.294 History of Eng Lit I 3
- 42.291 History of Am Lit I 3
- 42.201 Great Books of Antiquity or
- Free or Minor Elective 3
- Science* (Gen Ed) 3
- Intermediate Language I 3

15

Spring Semester

- 42.292 History of Eng Lit II 3
- 42.295 History of Am Lit II 3
- Literature (Gen Ed) 3
- Beh & Soc St (Gen Ed) 3
- Intermediate Language II 3

15

Junior Year

Fall Semester

- 42.307 Hist/Dev of Eng Lang or
- 42.308 Analysis of Modern English 3
- 42.3 Concentration Elective 3
- 42.3 Concentration Elective 3
- Science* (Gen Ed) 3
- Free or Minor Elective 3

15

Spring Semester

- 42.3 Concentration Elective 3
- 42.3 Concentration Elective 3
- Values, C & C (Gen Ed) 3
- Free or Minor Elective 3
- Free or Minor Elective 3

15

Senior Year

Fall Semester

- 42.423 Shakespeare I or
- 42.424 Shakespeare II 3
- 42.4 Concentration Elective 3
- Aesthetics (Gen Ed) 3
- Free or Minor Elective 3

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Spring Semester

- 42.4 Concen or Free Elective 3
- 42.4 Concen or Free Elective 3
- Free or Minor Elective 3
- Free or Minor Elective 3
- Free Elective 3

15

Department of English

You are required to take 15 credits at the 300 or 400 level. These credits include required courses like Shakespeare. Similarly, not counting required courses, such as English and American Literature, you cannot take more than two courses at the 200 level.

*Consult the Academic Policies section of this catalogue for the General Education requirements in math and sciences.

Writing Concentration:

Suggested programs for a course of study.

Freshman Year**Fall Semester**

42.101	College Writing I (Gen Ed)	3
92.	Math* (Gen Ed)	3
	Beginning Language I	3
	Beh & Soc St (Gen Ed)	3
	Minor Elective	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science* (Gen Ed)	3
	Beginning Language II	3
	Historical Studies (Gen Ed)	3
42.201	Great Books of Antiq or	
	Minor Elective	3
		15

Sophomore Year**Fall Semester**

42.294	History of Eng Lit I	3
42.291	History of Am Lit I	3
42.201	Great Books of Antiquity or	
	Minor Elective	3
42.227	Essay Writing-Engl Majors or	
	Science* (Gen Ed)	3
	Intermediate Language I	3
		15

Spring Semester

42.292	History of Eng Lit II	3
42.295	History of Am Lit II	3
42.227	Essay Writing-Engl Maj or	
	Science* (Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
	Intermediate Language II	3
		15

Junior Year**Fall Semester**

42.307	Hist/Dev of Eng Lang or	
42.308	Analysis of Modern English	3
42.3	Concentration Elective	3
42.3	Concentration Elective	3
	Science* (Gen Ed)	3
	Minor Elective	3
		15

Spring Semester

42.3	Concentration Elective	3
42.3	Concentration Elective	3
	Values, C & C (Gen Ed)	3
	Literature (Gen Ed)	3
	Minor Elective	3
		15

Senior Year**Fall Semester**

42.423	Shakespeare I or	
42.424	Shakespeare II	3
42.410	Editing & Publishing w/Lab	3
	Aesthetics (Gen Ed)	3
	Minor Elective	3
	Minor Elective	3
		15

Spring Semester

42.4	Concen or Free Elective	3
42.4	Concen or Free Elective	3
42.496	Practicum - Required	3
	Free or Minor Elective	3
	Free or Minor Elective	3
		15

Three courses from the following list must also be taken:

42.300	Journalism
42.309	Argumentation & Research Skills
42.305	Reviewing the Arts
42.390	Technical & Scientific Writing
42.402	Topics in Writing
42.391	Business Communication

Note: A 2.2 cumulative average is required to graduate. Some suggested minors: Computer Science (Math); Economics; Foreign Language; Psychology; Studio Art; or an elective concentration in Business courses (note: only College of Management majors may take 300-400 level courses). Students must arrange for their practicum experience with the Director or the Department Chairperson.

English Courses (Prefix: 42)**42.097 Intermediate English As A Second Language**

Preparation of selected students for College Writing I - International, with special emphasis on writing skills. Prerequisite: permission. 3 cr

42.098 College Writing A

Provides an intensive review of the basic rules of grammar and the basic principles of rhetoric necessary for success in College Writing I. Prerequisite: permission. 3 cr

42.101 College Writing I

Examines the writing process and reviews fundamentals of grammar, sentence structure, and paragraph development. Students analyze rhetorical models by professional writers and are introduced to library research and techniques of documentation. Seven expository essays are required. 3 cr

42.102 College Writing II

Reinforces the principles of good writing established in College Writing I. Students submit six essays based on critical analysis of readings in fiction, drama, and poetry. One documented research paper is required. Prerequisite: 42.101. 3 cr

42.103 College Writing I for International Students

For students who speak English as a second language. Equivalent to 42.101. Credit for both 101 and 103 not granted. 3 cr

42.104 College Writing II for International Students

For students who speak English as a second language. Equivalent to 42.102. Credit for both 102 and 104 not granted. 3 cr

Note: Students must complete requirements for College Writing I and College Writing II before registering for upper level English courses. Exception: English Majors may register for 42.102 and 42.201 concurrently.

42.201 Great Books of Antiquity

A study of representative literary selections from the Hebrews, the Greeks, the Romans, and other societies of the ancient world. 3 cr

COLLEGE OF ARTS AND SCIENCES*Department of English***42.202 Great Books of the Modern Period**

A study of representative literary selections from the period of the Enlightenment to the present. 3 cr

42.205 Human Values in Western Culture I

Addresses some of the important questions of human existence through a close study of representative literature from ancient times to the present. In the first semester students explore and evaluate three perennial themes: the problem of evil; self and society; freedom and fate. 3 cr

42.206 Human Values in Western Culture II

A continuation of 42.205. In the second semester the students explore and evaluate three perennial themes: the pursuit of knowledge; the nature of human-kind; the experience of love. May be taken independently of 42.205. 3 cr

42.210 Drama

A study of plays from the classical period to the present. 3 cr

42.211 Poetry

A study of poems from the Renaissance period to the present. 3 cr

42.212 The Short Story

A study of the development of the short story from Poe and Chekhov to the present. 3 cr

42.213 Biography

A study of selections from Plutarch to the present with emphasis on biography and autobiography as a source of ideas and values. 3 cr

42.216 The Short Novel

A study of nineteenth and twentieth century short novels as a literary genre. 3 cr

42.217 The Horror Story

A study of the genre. Focus on major writers from Poe to the present. 3 cr

42.218 Comedy

A study of the theory and practice of comedy from Greek writers to the present. 3 cr

42.219 Tragedy

A study of the theory and practice of tragedy from Greek writers to the present. 3 cr

42.222 Oral Communication

Development and application of basic speaking skills adaptable to a variety of personal and professional contexts. Practice skills include delivery and criticism of extemporaneous speeches. 3 cr

42.224 Business Writing

Theory and practice of letters, memoranda, and reports on specific business and technical problems. Restricted to students enrolled in the College of Management. 3 cr

42.225 Basic Technical Writing

An introduction to basic techniques and formats used for communicating technical and scientific information in the work place. Intended for engineering and science majors. Other majors must have instructor's permission. No COM majors. 3 cr

42.226 Technical and Scientific Communication

Theory and practice of letters, memoranda, reports, and oral presentations on specific scientific and technical problems. 3 cr

42.227 Essay Writing for English Majors

Class time is divided between analyzing and discussing the techniques and styles of selected professional essayists as well as the preparation of student essays. Emphasis is placed on the writing process from prewriting through drafting and revising. English majors and minors only. 3 cr

42.228 Word-Processing Laboratory

Adjunct to 42.227. Training in word processing skills: formulating, editing, revising, and printing texts; creating footnotes, glossaries, and indices; and other advanced applications. 1 cr

42.229 Essay Writing for Non-English Majors

Class time is divided between analyzing and discussing the techniques and styles of selected professional essayists as well as the preparation of student essays. Emphasis is on the writing process from prewriting through drafting and revising. Non-English majors only. 3 cr

42.230 Film Classics

A study of the elements of film as revealed in selected film classics. Emphasis on critical analysis and evaluation. 3 cr

42.231 The Documentary Film

History and theory of the documentary. Offered in conjunction with the Division of Continuing Education Summer Program. 3 cr

42.232 Turning Fiction into Film

A study of literary works and their film adaptations. Emphasis on analyzing what is at stake when the textual is adapted to a visual context. 3 cr

42.234 Modern Fiction and the Future

A study of English, American, and European novels which offer visions of the future based upon present political, social, and scientific trends. 3 cr

42.235 Writers of the Merrimack Valley

Writers of the Merrimack Valley is a survey of mostly contemporary regional authors. Students will read a series of books and write personal essays in response to reading assignments. 3 cr

42.236 Science Fiction

The course is designed to introduce students to understand science fiction and fantasy within the broader context of literature and literary theory. It attempts to develop and hone students' skills of critical analysis as it supplies them with the tools to "contextualize" their reading experiences - i.e., to understand the origins and politics of the books that they read. 3 cr

42.240 Literature and Women

A survey of literary attitudes toward women from the Judaic and Hellenic periods through the present. 3 cr

42.241 Women in Film

A survey of the image of women in commercial film from the beginnings to the present. Focus on films of the 1930's-40's and 1970's-80's. 3 cr

42.243 Contemporary Women Writers

A study of recent work in the novel, short story, drama, and poetry by British and American women. 3 cr

42.244 Women in the Middle Ages and Renaissance

A study of major literary and historical women of the Middle Ages and Renaissance. Attention to impact on their times and their place in society. 3 cr

42.250 The Bible as Literature

A reading of the Bible as literature, not forgetting that it is a library with its own requirements and aims. We also place the Bible in history considering the redactors, the formation of the canon, and translations. 3 cr

42.253 The Culture of American Sport

An examination of the history, literature, sociology, and aesthetics of sport. Attention to corollary issues and values including racism, sexism, and violence. 3 cr

42.257 The Family in Literature

A study of literary selections dealing with traditions of family life, the individual, and social change. 3 cr

42.259 Protest Fiction in America

A study of American fiction concerned with the oppression of blacks, working people, and the poor. 3 cr

42.261 Acting

Theory and practice of acting including exercises in the elements and methods of acting and the preparation of a public performance. 3 cr

42.262 Advanced Acting

A continuation of 42.261 which is a prerequisite. 3 cr

42.264 Directing

Introduction to the process of directing plays. Offered in conjunction with the Division of Continuing Education Summer Program. 3 cr

42.267 Introduction to Shakespeare

A study of selected histories, comedies, and tragedies. Not for English majors. 3 cr

42.272 Continental Fiction

A study of selected fiction by major continental writers of the nineteenth and twentieth centuries. 3 cr

42.274 Literature of the Beat Movement

A study of the Beat rebellion in the context of the 50's and 60's in America. Writers include Burroughs, Corso, Ferlinghetti, Ginsburg, and Kerouac. 3 cr

42.275 Oriental Literature in Translation

A study of traditional masterpieces from Persia, Arabia, India, China, and Japan with attention to historical and cultural backgrounds. 3 cr

42.276 Irish American Literature

A study of fiction, drama, poetry, and popular culture of the American Irish from immigration to the present. 3 cr

42.277 Cross-Cultural Perspectives in American Literature

The course addresses the literature of America's immigrant and cultural groups and how it contributes to defining our national character. 3 cr

42.282 Crime in Literature

A study of how various authors use crime as a plotting device to study character, reveal social order, and criticize social institutions. 3 cr

42.291 History of English Lit I

A survey of representative writers and works from the Anglo-Saxon period to the mid-seventeenth century. 3 cr

42.292 History of English Lit II

A survey of representative writers and works from Milton into the romantic period. 3 cr

42.293 History of English Literature III

A study of the historical development of English literature from the Romantic period to the present. 3 cr

42.294 History of American Literature I

A study of the historical development of American literature from the colonial period to the Civil War. 3 cr

42.295 History of American Literature II

A study of the historical development of American literature from the Civil War to World War I. 3 cr

42.296 History of American Literature III

A study of the historical development of American literature from World War I to the present. 3 cr

42.300 Intro to Journalism

An introduction to techniques of writing for the news media. 3 cr

42.301 Newswriting

Introduction to techniques of radio and television newswriting, to fundamentals of public affairs reporting, and to principles of newspaper editing. 3 cr

42.302 Creative Writing: Fiction

Theory and practice of fiction. Conducted as a workshop with close analysis of student work. 3 cr

42.303 Creative Writing: Poetry

Theory and practice of poetry. Conducted as a workshop with close analysis of student work. 3 cr

42.304 Creative Writing: Playwriting

Theory and practice of playwriting. Conducted as a workshop with close analysis of student work. 3 cr

42.305 Reviewing the Arts

Theory and practice of writing short, critical essays in a journalistic mode on the visual and performing arts. Special attention to theater, movie, and television criticism. Conducted as a workshop with close analysis of student work. 3 cr

42.306 Professional Writing

Process and procedures for writing professionally from the query letter to the final draft. Special attention to honoring editorial preferences and deadlines. 3 cr

42.307 History and Development of the English Language

A study of the phonetic, lexical, syntactical, and semantic shifts in the English language from its beginnings to the present. 3 cr

42.308 Analysis of Modern English

A study of English syntax examining traditional, structural, and transformational grammars. Attention to issues of dialect, usage, phonology, and morphology. 3 cr

42.309 Argumentation and Research Skills

Analyzing and writing arguments. Emphasis on the claim, support, and warrant approach to argumentation. Attention to research skills and bibliographic techniques. 3 cr

42.311 The South in American Literature

A study of the writers, movements, and social culture of the South, including such representatives as Douglass, Hellman, Ransom, the Fugitives, and Faulkner. 3 cr

42.312 American Puritanism as Literary Influence

A study of Puritan values in selected colonial writings and in confrontation with other values in nineteenth-century literature. 3 cr

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42.313 Realism and Naturalism in American Fiction

A study of realism and naturalism in fiction from the end of the Civil War to World War I. 3 cr

42.317 British Literature of the Twentieth Century

A study of twentieth-century British short stories, novels, poetry, and drama. 3 cr

42.318 American Literature of the Twentieth Century

A study of twentieth-century American novels, short stories, poetry, and drama. 3 cr

42.320 Personal And Reflective Writing

A workshop format encourages peer criticism of individual writings and discussion of models from various texts. 3 cr

42.323 Writing About People

Primarily writing essays, but other forms such as interviews and stories may also be used. Topics include family members as well as people you have less experience of; you also read and write about other authors writing about people in a variety of forms. Meetings emphasize participation in workshops. 3 cr

42.324 Writing About Nature and the Environment

A study of literature that depicts the natural world. Reading and writing about such authors as Dillard, Abbey, Erlich, Leopold, and Silko. Consideration of environmental concerns expressed by these writers. 3 cr

42.325 The Rise of the Novel

A study of the British novel in the eighteenth century from DeFoe through Austen. 3 cr

42.326 Nineteenth Century British Novel

A study of the novel from Scott through Hardy. 3 cr

42.330 Twentieth Century British Novel

A study of the novel from Conrad through Greene and others. 3 cr

42.331 American Novel to 1900

A study of the American Novel from colonial beginnings to 1900. 3 cr

42.332 Twentieth Century American Novel

A study of the American Novel from 1900 to the present. 3 cr

42.335 American Women Novelists

A study of selected novels by American women. Focus on the female voice within the American tradition. Treatment of such issues as domesticity, education, and authorship. 3 cr

42.345 Female English Novelists

Selected novels by writers such as Austen, the Brontës, Eliot, Woolf, Bowen, and Drabble. 3 cr

42.347 Modern Irish Drama

A study of the evolution of the Irish stage to the present - from Yates to Friel. 3 cr

42.348 Modern American Drama

A study of such playwrights as O'Neill, Odets, Wilder, Williams, and Miller. 3 cr

42.349 Introduction to the Hebrew Bible

Close reading of selected texts from the Pentateuch prophets and writings. Exploration of major Biblical themes: God and humankind; self and society; sin and evil; love and sexuality; sanctity and wisdom. 3 cr

42.351 Literature of the Middle Ages

A study of the prose, poetry, and drama of England from 1200-1500 set against cultural and historical backgrounds. 3 cr

42.352 Literature of the Sixteenth Century

A study of English prose and poetry of the period. 3 cr

42.353 Literature of the Seventeenth Century

A study of English prose and poetry of the period excluding Milton. 3 cr

42.354 Literature of the Eighteenth Century

A study of English prose and poetry of the period. 3 cr

42.355 Literature of the Romantic Period

A study of English prose and poetry from 1798 to 1832. 3 cr

42.356 Literature of the Victorian Period

A study of British fiction, poetry, and prose from 1830 to 1900. 3 cr

42.358 The Shaping of the American Theatre

A study of 18th, 19th, and 20th century playwrights and trends that shaped the modern American theater. Focus on key writers influencing trends. 3 cr

42.359 Contemporary World Drama

A study of important recent works by playwrights from around the globe. 3 cr

42.360 Medieval & Renaissance Theater

A study of medieval mystery cycles, morality plays, interludes, and other forms of popular and court theater. 3 cr

42.361 Restoration Comedy

A study of comic plays from 1660 to the mid-eighteenth century. Focus on the works of Etherege, Wycherley, Congreve, and Sheridan. 3 cr

42.362 Modern Drama

A study of selected Continental, British, and American plays from the late nineteenth century to the present. 3 cr

42.363 Elizabethan & Jacobean Drama

A study of major dramatists of the Age of Shakespeare including Marlowe, Dekker, Webster, Jonson, Beaumont and Fletcher, Massinger, Ford, and others. 3 cr

42.365 Fiction II

Advanced workshop in writing fiction. Offered in conjunction with the Division of Continuing Education Summer Program. 3 cr

42.366 Poetry II

Advanced workshop in writing poetry. Offered in conjunction with the Division of Continuing Education Summer Program. 3 cr

42.367 Playwriting II

Advanced workshop in writing plays. Offered in conjunction with the Division of Continuing Education Summer Program. 3 cr

42.370 Contemporary American Fiction

A study of novels and short fiction from World War II to the present. 3 cr

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42.371 Contemporary British Fiction

A study of novels and short fiction from World War II to the present. 3 cr

42.372 Contemporary World Literature

A comparative study of literary works in English from India, Africa, Australia, the Caribbean, and other areas of multicultural tradition. 3 cr

42.373 Modern Poetry

A study of the development of British and American poetry from 1900 through World War II. 3 cr

42.374 Contemporary Poetry

A study of selected British and American poets since World War II. 3 cr

42.375 Modern Irish Literature

A study of Irish writing from 1890 to the present. Emphasis on the work of Yeats, Joyce, Synge, O'Casey, O'Connor, and O'Faolain. 3 cr

42.376 African-American Fiction

A study of selected works by black American writers, such as Toomer, Wright, Ellison, Walker, and Morrison. 3 cr

42.379 Aging, Illness, and Death

A comparative study of attitudes toward aging, illness, and death as portrayed in selected literary works examined in their historical and cultural contexts. 3 cr

42.380 War in Literature

A study of conflict and human values in times of war. Focus on fiction and poetry treating World War I, World War II, and Vietnam. 3 cr

42.381 The Existential Hero

A study of the evolution of the existential hero in European and American literature and film. 3 cr

42.383 Literature and Science

A study of literary works dealing with science and its cultural implications. Topics include "the two cultures," the scientist as hero, the scientist as writer, and science fiction. 3 cr

42.387 Editing & Publishing Techniques

A study of basic editorial techniques and specific application in the context of present-day publishing. 3 cr

42.388 Undergraduate Seminar on the Teaching of Writing

Training in writing theory for direct application in peer tutoring. Discussion supplemented by experiential exercises, class presentations, reading, and writing. Meets two hours each week. Students tutor four hours each week. 3 cr

42.390 Technical and Scientific Writing

A study of and practice with techniques and formats used for communicating technical and scientific information. Primarily for students considering careers in or associated with technical writing. Intended for English majors and minors. Other majors must have instructor's permission. No COM majors. 3 cr

42.391 Business Communication

A study of the special problems of writing in business including strategies for correspondence, presentation of complex information, and writing for sales. For English majors and minors. 3 cr

Note: Courses numbered 400 and above are restricted to English majors and minors.

42.401 Selected Authors

A study of selected works. Authors to be announced each semester. 3 cr

42.402 Topics in Writing

A study of issues and the practice of skills needed in specific areas of professional writing. Topics to be announced each semester. 3 cr

42.403 Special Topics: Feature Writing

Discussion and practice of skills necessary for newspaper feature writing. Special attention to lead writing, the "nut" paragraph, attribution, transitions, dialogue, and the inverted pyramid. Field experience. Guest writers and editors. Preparation of submissions for publication encouraged. Prerequisite: 42.300 3 cr

42.404 Special Topics: Freelance Journalism

Discussion and practice of the strategies and skills necessary to writing and publishing as a freelance journalist from query letters to "stringing" and developing a niche. Prerequisite: 42.300 3 cr

42.411 Desktop-Publishing Laboratory

Adjunct to 42.387. Advanced word-processing and computer-assisted proofing

and page layout. Desktop technology related to printing, including font manipulation and graphic design. 1 cr

42.415 Young Adult Literature - Critical Methods

Using young adult literature as a vehicle, this course considers traditional methods of interpretation and evaluation. Particular attention is given to the analytical, psychological and sociological approaches. 3 cr

42.421 Chaucer

A study of the major works of Chaucer in Middle English. 3 cr

42.423 Shakespeare I

A study of selected histories, comedies, and tragedies. 3 cr

42.424 Shakespeare II

A study of selected histories, comedies, and tragedies not covered in 42.423. Readings in Shakespeare I and II to be announced each semester. 3 cr

42.426 Milton

A study of the major poems and selected prose. 3 cr

42.429 Introduction to Literary Theory

A solid introduction to major trends in contemporary critical theory. Emphasis on producing a sample critical paper treating one or more current critical approaches to reading a literary text. 3 cr

42.430 Literary Criticism

A study of major statements about literature from Aristotle and Plato through contemporary critics. 3 cr

42.431 Contemporary Linguistic Theory

Examines how and why children acquire the complex rules of grammar (linguistic competence) as well as the rules of the appropriate social use of language (communicative competence). The focus of the class is on the linguistic subsystems which enable us to describe the stages of language development. 3 cr

42.450 Writing Workshop

A substantial writing project is developed through collaborative efforts of a student's major department and the Department of English. Permission of Chairperson required. 3 cr

Directed Studies

The English Department offers directed studies for English majors only. Students may enroll in these courses provided that 1) they have at least a 3.000 average for English courses, 2) the material to be covered is not available in any English course offered during the semester in which directed study is contemplated, 3) instructors are willing to undertake a directed study, and 4) arrangements for directed study are made through the English Department Chairperson. A maximum of six credits in the major field may be acquired through registration for directed studies courses.

42.491 Directed Study in Literature

The student develops a course of directed reading, defines a problem for individual research, and prepares a paper or papers. 3 cr

42.492 Directed Study in Language Analysis

The student develops a course of directed readings in linguistics, semantics, or stylistics and defines a topic for individual research. 3 cr

42.493 Directed Study in Creative Writing

The student develops a series of projects in creative writing and composes poetry, fiction, or drama. 3 cr

42.496 Practicum

An off-campus writing experience for English majors. Practicum experience is intended to provide students with the opportunity of applying their writing skills in actual business, technical, or professional situations. 3 cr

Department of History

Charles F. Carroll, Chairperson

Professors: Harald Bakken, Christos Bantas, Mary Blewett, Peter Blewett, Charles Carroll, Liana Cheney, Jonathan Liebowitz, Donald Mattheisen, Francis Walsh

Associate Professors: Richard Derry (Emeritus), George Luter, John Shea

Assistant Professor: Alice Walters

Affiliated Faculty: Dean Bergeron, Lawrence Gross

History Major

The Department of History provides students with a broad introduction to civilizations of the past and present including those of antiquity, Europe, America, and the Third World. Through a broad exposure to the complexities shaping the forces of civilization, the history major develops a thorough grounding in the historical process, a greater empathy, and a special perspective for viewing human thought and action. The student of history is aware of the distinctiveness of past individuals and societies but also recognizes the continuities connecting the experiences of different people over time. Sensitive to the realities of continuity and change, the student of history develops the ability to determine bias, to make valid generalizations, to draw valid inferences, and to perceive the significance of fact within the framework of interpretations. A major in History provides a meaningful background for students who desire to enter government service, politics, law, teaching, or business.

The major in History consists of 36-45 credits (with at least 15 credits at the 300 course level or above) and must include the following:

- 43.105 Western Civ to 1715
- 43.106 The Modern World
- 43.299 Intro to Historical Method
- 43.432 Research Seminar in History*

*not an absolute requirement, but recommended for students planning advanced study

The Department also requires two courses on or above the 200 level in both European and American History, two addi-

tional courses in either European or American History, and one of the following courses dealing with the Third World: 43.272, 273, 290, 293, 295, 318, 321, 387, 393. The Third World requirement also may be fulfilled with 46.368, Middle East Politics, which carries history credit. A maximum of six credits in United States history survey courses may be counted as part of the first 36 credits for the history major. The remaining courses for the major may be selected from any of the history courses at the 200-level and above.

Students transferring to the College who wish to major in history must make individual arrangements with the Chairperson of the Department regarding satisfaction of major requirements.

The Department offers two additional specialized concentrations within the major which are designed to take advantage of the strengths of the faculty and the immediate locality. They are: 1) the American Industrial Revolution and 2) Modern European Social and Economic History. Students interested in these concentrations should contact the Chairperson for more information.

Minor Requirements

American History

A minor in American History consists of 18-24 credits. At least six credits must be taken in courses at the 300 level or above. Coursework is selected in consultation with the faculty advisor.

European History

A minor in European history consists of 18-24 credits. At least six credits must be taken in courses at the 300 level or above. Coursework is selected in consultation with the faculty advisor.

General History Minor

A minor in history consists of 18-24 credits. At least six credits must be taken in courses at the 300 level or above. Coursework is selected in consultation with the faculty advisor.

Interdisciplinary Minors

Students should refer to the listing of interdisciplinary minors in the social sciences and humanities, which is at the end of the College of Arts and Sciences section of this catalogue.

Department of History

General Requirements

The history major consists of 36-45 credits and at least 15 credits at the 300/400 level.

Course of Study

For students entering in Fall 1993 and subsequently

Freshman Year**Fall Semester**

42.101	College Writing I (Gen Ed)	3
43.105	Western Civilization to 1715	3
	Beginning Language I	3
92.	Mathematics* (Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
43.106	The Modern World	3
	Beginning Language II	3
	Science I* (Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
		15

Sophomore Year**Fall Semester**

43.	U.S. History Elective	3
43.	European History Elective	3
	Literature (Gen Ed)	3
	Science II* (Gen Ed)	3
	Intermediate Language I	3
		15

Spring Semester

43	European History Elective	3
43.299	Historical Methods	3
	Aesthetics (Gen Ed)	3
	Science III (Gen Ed)	3
	Intermediate Language II	3
		15

Junior Year**Fall Semester**

43.	Third World History Elective	3
43.	History Elective	3
	Values, C & Choice (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

43.	U.S. History Elective	3
43.	History Elective	3
	History Elective	3
	Free Elective	3
	Free Elective	3
		15

Senior Year**Fall Semester**

43.	History Elective**	3
	History or Free Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

	History or Free Elective	3
	History or Free Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

*Refer to the Academic Policies section of this catalogue for the General Education requirements in mathematics and the sciences.

**43.432 Research Seminar may be required for entry into some graduate programs. The Department recommends this course for all students who plan to apply for graduate programs in History.

**History Courses
(Prefix: 43)****43.101 Classical Civilization**

Political, social and cultural history of the Graeco-Roman world from the age of heroes to the fall of the Roman Empire. (Not open to History concentrators.) Bentas 3 cr

43.105 Western Civilization to 1715

Traces the major forces in the development of European history from the beginning of Greek civilization to 1715. 3 cr

43.106 The Modern World

Examines the major forces in the development of modern European history in a global context from the origins of the French Revolution to the present. 3 cr

43.111 United States History to 1877

Traces the development of American History and institutions from Colonization to the end of Reconstruction. 3 cr

43.112 U.S. History Since 1877

Examines significant developments in American History from the end of the Reconstruction Period to the present. 3 cr

**43.201 History of Science I: The
Invention of Science**

Explores the rise of the modern understanding of nature and the natural world as it developed in Western Europe. Beginning with the establishment of universities and their elaboration of Aristotelian ideas and methods and the various institutional and cultural contexts in which they developed through the Renaissance, Scientific Revolution, and Enlightenment. Walters 3 cr

43.202 Science and the Modern World

Examines the role of science in European and American society through the nineteenth and twentieth centuries. The course explores the development of new scientific theories in the life sciences and the physical sciences (including evolution, relativity, quantum mechanics, and genetics), addresses the institutionalization of science in Western society, and considers how science came to be applied to various social, cultural, and military concerns of the modern world. Walters 3 cr

43.206 American Economic History

A study of the growth and development of the American economy from its European origins to the present. 3 cr

**43.210 History of American Popular
Culture**

An investigation of the social content and institutional character of mass culture in America since 1850. Walsh 3 cr

43.216 American Urban History I

An examination of the process of urbanization in America. Topics covered include the origin and development of the American city, ethnic conflict, the political machine, police and transportation. Walsh 3 cr

43.217 American Urban History II

A continuation of 43.216. Topics include poverty, housing, health delivery, suburbanization, and city planning. Walsh 3 cr

COLLEGE OF ARTS AND SCIENCES

Department of History

43.225 Ancient Greek History and Civilization

A study of Greek history, institutions and culture from Minoan times through the Hellenistic period. Bentas 3 cr

43.226 Roman History and Civilization

An analysis of the history, institutions and culture of the Roman Empire from the earliest times to 330 A.D. Bentas 3 cr

43.227 The Middle Ages

A survey of the Latin West during the formative period from the Roman Empire to the creation and development of the first European civilization. 3 cr

43.231 Renaissance and Reformation

The history of Europe in the time of transition between the late Middle Ages and the Early Modern Period. Two principle topics are the intensification of cultural change which began in Italy around 1300 and spread slowly northward and the disruption of the unity of the Western Christian Church. P. Blewett. 3 cr

43.237 Europe in the Twentieth Century

An examination of selected topics in European history from 1914 to the present: World War I, the Versailles conference, unrest and collapse of collective security, the rise of Communism, Fascism, Nazism, World War II and post war developments. Shea, Liebowitz 3 cr

43.242 The Second World War

A general survey of the war together with a closer examination of selected topics. Mattheisen. 3 cr.

43.255 The History of Germany to 1871

Political and cultural development of the German nation from the Reformation to the creation of a unified nation-state in the nineteenth century. Topics include the Renaissance and the Reformation, the Thirty Years War, the rise of Brandenburg-Prussia, German absolutism in the era of Frederick the Great, the German Enlightenment, the upheaval of the French Revolutionary era, and the growth of German nationalism. Mattheisen 3 cr

43.258 The History of Russia to 1796

The growth of the Russian state: Varangian origins, the Kievan state, conversion to Christianity, Mongol domination, the rise

of Muscovy, Europeanization and expansion under Peter the Great and Catherine the Great. Shea 3 cr

43.261 Greek and Roman Historians

Extensive reading in English translation of important Greek and Roman historians. Works of Herodotus, Thucydides, Xenophon, Livy, Tacitus, and Procopius. Bentas 3 cr

43.270 Women in American History

A study of women as a social group in American History. M. Blewett 3 cr

43.272 The American Indian

A study of the American Indian before the introduction of white European civilization. The course examines the history and culture of selected tribes of several regions within the present boundaries of the United States. Luter 3 cr

43.273 American Indians and the U. S.

A study of the conquest and domination of American Indians from the formation of the United States government to the present. The course focuses on the evolution and implementation of Indian policy and the forces which influenced U. S. relations with Indian tribes. Luter 3 cr

43.277 Ethnic Groups in American Life

An examination of the importance of ethnic groups in American history. The course treats several major ethnic groups and their assimilation or non-assimilation into American life. Field work and research on ethnic groups in the Merrimack Valley. Bakken 3 cr

43.279 History of Lowell

The history of industry, politics, and culture in the city of Lowell. 3 cr

43.290 The Orient Since 1500

This survey concentrates on China, Japan, and India as the three dominant contemporary civilizations. The course begins with an analysis of them as traditional societies and then traces their history in response to the impact of aggressive modernizing states of Western Europe and America. P. Blewett. 3 cr

43.291 Conquest of the Americas

A study of the conquest and domination of the native peoples of the Western hemisphere by the imperialist powers of Europe and the succeeding governments of the Americas. The course focuses on the

development and implementation of policies of the dominant governments, from discovery to the present. Luter 3 cr

43.293 Latin American Civilization

An introduction to Latin American history through the study of selected topics from the age of discovery and conquest to the present. The course emphasizes Spanish imperial policies, the evolution of modern national states, and the impact on the indigenous population. Luter 3 cr

43.295 History of Japan Since 1600

A study of the traditional Japanese institutions and the transformation of Japan into a modern state after 1868: the Tokugawa Shogunate, Meiji Restoration, Russo-Japanese War, world power status, militarism, World War II, and present day Japan. Shea 3 cr

43.299 Introduction to Historical Method

An introduction for the undergraduate student to the nature and principles of history. The course takes up methodology, historiography, research methods, bibliography, and the technical and stylistic problems involved in the presentation of research in scholarly form. Required of all history majors in the sophomore year. Non-majors are admitted with permission of the instructor. 3 cr

43.302 Byzantine History and Civilization

A study of the important political, social, and cultural changes in the East Roman Empire from the founding of Constantinople to the fall of the Empire in 1453 with emphasis on the role of Byzantium as the custodian of the classical past. Bentas 3 cr

43.304 European Social and Economic History Since the Industrial Revolution

The causes of the industrial revolution and the process of industrialization. Life in the urban, industrial world. New ideologies, new types of social organization, and European economic integration. Liebowitz 3 cr

43.305 American Intellectual History to 1880

Selected topics in intellectual history from colonial times to the Civil War. The course examines the major intellectual currents and the interaction between ideas and

social structure. Topics include: Puritanism, political philosophy, the pursuit of an American style, slavery and the sectional conflict, transcendentalism and social reform, and Social Darwinism. Bakken 3 cr

43.306 American Intellectual History Since 1890

Selected topics in intellectual history, concentrating on the twentieth century thinkers. Topics include: pragmatism and its critics, 20th century political thought, critiques of American values, and Black social thought. Other topics will be selected by students. Prerequisite: 43.305 or permission of the instructor. Bakken 3 cr

43.308 History of Crime, Conflict, and Control in the United States

An analysis of the causes and development of attempts to control crime, ethnic conflict, radical protest movements, urban disorders, and attitude and role conflicts. Walsh 3 cr

43.310 History of New England

Explores the evolution of New England society from pre-Columbian to the Post-Industrial, emphasizing the ways succeeding generations of New Englanders have confronted social and economic change. Topics include: white-Indian relations, ecological change, Puritanism, the New England town, the industrial revolution, the rise of cities, immigration, ethnic and class conflict, and the distinctiveness of the region. Karr 3 cr

43.313 American Social History to 1880

Selected topics in American social history, including mobility and class structure, religion, ideals of family life and child rearing, race and ethnic groups, and myths and reality in economic life. Bakken 3 cr

43.314 American Social History Since 1880

A continuation of the preceding. Prerequisite: 43.313 or permission of the instructor. Bakken 3 cr

43.315 U.S. Women in Fiction

Literature often has been used by historians as source material for the lives of the American people. An examination of literature written by American women about the lives of various groups of American women yields insights into their position in nineteenth and twentieth-century

American society. The explosion in women's studies has produced many reprints of published works available for this course, which will be a reading and discussion seminar. Prerequisites: 43.270 Women in American History, an equivalent women's studies course, or permission of the instructor. M. Blewett 3 cr

43.318 Precolumbian America

A study of the native inhabitants of the Western Hemisphere from arrival to discovery by Europeans. The course focuses on the history and development of the social, economic and political institutions and the intellectual and artistic achievements of the major civilizations, in particular the Maya, Aztec, and Inca. Luter 3 cr

43.321 Modern Latin America

An analysis of significant trends and problems of Latin America with emphasis on the economic, political, and social conditions that stimulate or deter progress. Luter 3 cr

43.325 Christianity and Rome

Analyzes the late stages of the civilization of antiquity. The center of interest is the interaction of the new world-religion of Christianity with the mature Roman Empire: a cultural and political conflict which irrevocably changed the world. P. Blewett. 3 cr.

43.327 England in the Middle Ages

The history of the English people and nation from the Roman conquest to the end of the fourteenth century with special emphasis on the development of political and social institutions. 3 cr

43.330 Tudor England

An intensive study of the social, economic, and constitutional structure of England in the 16th century. The course begins with a review of the problems of the period 1399-1485. P. Blewett 3 cr

43.331 Stuart and Augustan England

A sequel to 43.330 (which is not a prerequisite). This course deals with the great revolution of the 17th century and its aftermath and concludes with the emerging political stability to 1760. P. Blewett 3 cr

43.334 The French Revolution and Napoleon

A close analysis of French society from 1600-1815 which attempts to understand the cause of the French Revolution and its aftermath. P. Blewett 3 cr

43.336 Problems of Modern Ireland

Study and discussion of problems of 20th century Ireland set in their historical perspective. 3 cr

43.340 Topics in the History of Science

This course focuses on specialized topics in the history of science. Such topics might include several of the following: the role of women in western science, gender and science, the relationship between scientific and occult beliefs, the nature of scientific revolutions, and the sociology of science in different historical contexts. There are no prerequisites, but students should have had some history courses; 43.201 or 43.202 are recommended. Walters 3 cr

43.350 Colonial America: History and Culture

Emphasis is on the British North American and Caribbean colonies of the 17th and early 18th centuries. Topics include: the impact of European pandemic diseases on the native American populations; new European technologies and the transformation of the environment; contrasts between religious, social, and economic developments in New England and those in the settlements to the south; a comparative analysis of slavery; and the beginnings of modernism. Carroll 3 cr

43.352 The Coming of the American Revolution

A study of 18th-century British America with emphasis on the paradoxes of unity and diversity, Anglophilia and Anglophobia, slavery and freedom, and enlightenment rationalism and evangelical religion. The course also deals with the major causes, events, and interpretations relating to the coming of the American Revolution. Carroll 3 cr

43.353 The American Revolution and the Beginnings of Constitutional Government

A study of the War for Independence, the creation of republican forms of government, and the formation of the Federal Constitution. Carroll 3 cr

43.354 The American Revolution and Social Change

An examination of the far-reaching social, political, and economic consequences of the revolt of the thirteen colonies against British rule. Carroll 3 cr

43.356 Civil War and Reconstruction

Examines the Civil War and Reconstruction, not only in terms of events but also in the light of traditional and revisionist interpretations. Bergeron 3 cr

43.360 The Gilded Age: United States History, 1877-1900

An examination of the social, cultural, and political changes involved in the development of the United States as a modern industrial nation and its rise to status as a world power. M. Blewett 3 cr

43.362 The 20's and the 30's

An examination of the emergence of the corporate and governmental institutions of modern America set in two turbulent decades of cultural and political ferment that involved both booming prosperity and the economic collapse of the Great Depression. M. Blewett 3 cr

43.363 Recent U. S. History: 1940 to the Present

The involvement of the U.S. in World War II marked a major turning point in American history. It ushered in decades of Cold War tensions, the militarization of society, participation in foreign alliances, and limited wars. Anti-communist conservatives, militant Blacks, and a New Left polarized politics produced a contemporary crisis of confidence in American society. M. Blewett 3 cr

43.364 War and Cold War: United States History in the 1940's and 1950's

An in-depth examination of the economic, political, social, and cultural consequences of World War II and the development of the Cold War. M. Blewett 3 cr

43.365 United States History Since 1960

A survey of Cold War politics and civil rights upheavals during the 1960s and 1970s, the decline of American economic and political power, and the resurgence of conservative politics in the 1980s. M. Blewett 3 cr

43.366 History of Germany Since 1871

Examines the meteoric rise and fall of modern Germany as a world power in its various manifestations as the German Empire, the Weimar Republic, and the Nazi state. Some attention is also given to the unification of East and West Germany

and to the continued influence of the "German Question" in world affairs. Mattheisen 3 cr

43.367 France Since 1814

A History of France in a broad European setting from the Bourbon restoration through the Fifth Republic. The course intensely examines the interaction of social, economic, political, and diplomatic trends, with particular attention to the struggle between the Right and the Left. Shea 3 cr

43.369 Russia in the 19th and 20th Centuries

Selected topics in modern Russian history: political and social reforms of the nineteenth century, international policies in Europe and Asia, the 1917 revolutions, development of the new regime under Lenin, Stalinist policies, World War II and Russian expansion. A comparative study of these topics underscores patterns of continuity in both Tsarist and Communist Russia. Shea 3 cr

43.370 Medieval Institutions

An overview of selected political, social, and cultural forms in medieval society. The emphasis is on origins, growth, change, and the interaction of institutions. Topics vary from year to year. 3 cr

43.377 Modern European Imperialism

Motives, methods, and results of imperialism in the nineteenth and twentieth centuries: the partition of Africa and penetration of Asia as contrasting phases in the expansion of Europe. Shea 3 cr

43.380 Work and Society

A survey of labor history from the colonial period to the present focusing on the interrelationships between culture and work in American society and on the dynamics of technical and economic changes on the organization of work processes. Gross 3 cr

43.381 The United States in the 1960s

An examination of the tumultuous decade in which society and politics were torn apart by the civil rights movement, the Vietnam War, and the rise of a counter culture. M. Blewett 3 cr

43.382 The American West

Readings and discussion of the history of the American West and the place of the frontier in American society and thought. Bergeron 3 cr

43.383 Technology and American Culture

An interdisciplinary study of the interrelationships among technological, economic, social, and cultural forces in America from the colonial era to the early twentieth century. Topics include: three-dimensional thought and pre-industrial empirical technology, the codification and transfer of technology, the beginnings of the American industrial revolution, the development of engineering as a profession, and the emergence of scientific technology. Special emphasis is given to developments in wood-based technologies, water and steam power, textiles, iron and steel, electric communications and power, petroleum, and the internal combustion engine. Carroll 3 cr

43.384 Radicalism in American History

A biographical approach to the influence of radicalism on American history with emphasis on significant and representative personalities and their contributions. Bergeron 3 cr

43.385 History of Family and Childhood in the United States

An analysis of the status of children, the role of the family, and the effect of other institutions on children and family throughout American history. Includes the historical study of an individual family. Bakken 3 cr

43.386 Humor and Satire in American Social and Political Thought

Analyzes the role of humor and satire in American political and social thought: fiction, editorial and social cartoons, film, drama, popular entertainment, and oral tradition. Bakken 3 cr

43.387 The American Indian in the 20th Century

A study of Indian-white relations from the early twentieth century to the present. The course investigates the problems that currently confront Native Americans and their possible solutions; government legislation, agencies and policies that affect American Indians; and the response of tribal government and organizations. Luter 3 cr

43.393 History of the Middle East

An introduction to Islam and the history of the Middle East from Mohammed to the present. The course focuses on Islamic values as they impact upon our own culture and value system. Bergeron 3 cr

*Department of Languages***43.395 Computer Methods in History and Political Science**

The application of statistical methods to problems in history and political science. Students undertake a series of projects using the computer. The course is open to students from all majors. No previous experience is assumed. Liebowitz 3 cr

43.420 Twentieth Century Regional and International Organizations

Students take part in a simulation of the proceedings of a regional or international organization, e.g., U.N., O.A.S., O.A.U., or the Arab League. They study all aspects of the selected institution but concentrate on key economic, social, and security issues discussed in the body's debates. The aim of the course is to give students a clearer understanding of the forces and constraints that shape the foreign policies of individual states. Bergeron 3 cr

43.432 Research Seminar in History

Systematic research in primary and secondary sources culminating in the writing of an original research paper using proper methodological and stylistic techniques. Weekly meetings and written and oral progress reports. Students must be acquainted with word-processing techniques. Required of all History majors. Department faculty. 3 cr

Directed Studies

Directed Study courses are available only to History majors and may be selected provided that 1) the material to be covered is not available in any course to be offered in the semester in which the directed study is to be taken, 2) instructors are willing to undertake a directed study course, and 3) no more than nine credits in the major field are earned in directed study courses.

43.485 Advanced Tutorial in History

A program of directed study in which the student, through regular consultation with the instructor, develops an evaluative and critical essay. The purpose is to sharpen and refine techniques of scholarly research in the student's major discipline. Prerequisites: demonstrated proficiency in an area selected for directed study and permission of instructor and Chairperson. 3 cr

43.491 Directed Study in History

Directed study offers the student the opportunity to engage in an independent study or research project under the supervision of a department member. Working closely with the instructor, students define and investigate a research topic in an area of special interest and present the results of their investigation in a significant paper. Juniors and seniors only. Prerequisite: permission of instructor and Chairperson. 3 cr

Practicum**43.496 Practicum Experience**

A program of on-campus and off-campus experiences for history majors only. Specific requirements vary depending upon the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated for a maximum of nine credits. Students are graded "satisfactory" or "unsatisfactory." The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson. 3 cr

Department of Languages

Mario Aste, Chairperson

Professors: Mario Aste, Joseph Garreau, Heli Hernandez, Herlinda Saitz

Associate Professors: John Staulo (Emeritus), Robert Whelan

The Languages Department focuses on the major intellectual concern of this century and the next—that of communication. Serving as the paradigmatic model for thinking in the human sciences, language occupies a high rung in the conceptualization of numerous disciplines and sign systems. The Department of Languages fosters an understanding of language as a system and a model of communication in its cultural context, in addition to providing skills in a number of languages. The study of languages is a study in the acquisition of perspective and, ultimately, freedom from narrow cultural or disciplinary confines. At the same time, the College recognizes the community contribution of language and cultural programs in the various linguistic groups of the region.

The specific areas of the Department include instruction and study in languages, literature, linguistics and culture.

Language courses are extensively attended by students from other colleges within the University, underscoring the importance and viability of language programs for those in professional, scientific, business and technical fields.

The Department of Languages offers majors leading to the Bachelor of Arts Degree in Modern Languages, with the following concentrations: a) Modern Languages - General, b) Modern Languages, French, c) Modern Languages - Spanish.

Also offered are minors in French, Greek, Spanish; and, in cooperation with other departments, Classical Civilization, Film Studies, German Studies, Italian Studies and Latin American Studies.

Major Requirements**Modern Languages - General**

The major in Modern Languages provides varied options for students who are interested in languages, not only from the viewpoint of a possible marketable skill but

COLLEGE OF ARTS AND SCIENCES*Department of Languages*

also as a means of communication with people who speak a language which is different from their own.

A student may combine the Modern Language concentration with other supporting studies, thus tailoring an undergraduate program to meet individual career objectives.

The Modern Language major consists of 36-45 credits above the 100 level (with at least 15 credits at the 300 level or above) and includes the following options:

- Option I (French and Spanish)
- Option II (French or Spanish) plus another language (Italian or German)

Typically, students earn 24 credits in one language and 12 credits in the other. They may also elect a program with 18 credits in each language.

Students who transfer to the College and who wish to major in Modern Languages must make individual arrangements with the Chairperson regarding satisfaction of major requirements.

Modern Languages - French Option

The French concentration provides a broad liberal arts education for students interested in developing a proficiency in the French language, a general knowledge of the cultural and literary heritage of French civilization, and a basic insight into the function of verbal symbols in the process of human thought. This concentration provides students with sufficient preparation for a career in language teaching or bilingual education or for business or social-service careers requiring a command of the French language. A student may combine the French concentration with other supportive studies, thus tailoring an undergraduate program to meet his/her individual career objectives.

The major in Modern Languages - French consists of 30-45 credits (with at least 15 credits at the 300 course level or above) and normally will include a combination of 18 credits in language, 12 in literature courses and three credits in culture courses.

50.221	Reading/Conv French I	3 cr
50.222	Reading/Conv French II	3 cr
50.246	Adv French Conversation	3 cr
50.310	French Speaking World	3 cr
50.348	Adv French Composition	3 cr

Additional coursework beyond the prescribed courses may be elected from the French offerings of the Department to a maximum of 45 credits. Students who transfer to the College and who wish to major in Modern Languages - French must make individual arrangements with the Chairperson regarding satisfaction of major and collateral course requirements.

Modern Languages - Spanish Option

The Spanish concentration provides a broad liberal arts education for students who are interested in developing a proficiency in the Spanish language, a broad knowledge of the cultural and literary heritage of Spanish and Latin American civilization, and a basic insight into the function of verbal symbols in the process of human thought. This major provides students with sufficient preparation for a career in language teaching and bilingual education and for business and social service careers requiring a command of the Spanish language. Students may combine the Spanish concentration with other supporting studies and may tailor their undergraduate program to meet their individual career objectives.

The major in Modern Languages - Spanish consists of 36-45 credits (with at least 15 credits at the 300 level or above) and normally will include 18 credits in language courses, 15 credits in literature courses, and three credits in cultural courses.

54.222	Reading /Conv Spanish II	3 cr
54.245	Adv Spanish Conversation	3 cr
54.347	Adv Spanish Composition	3 cr
54.350	Intro to Literary Analysis	3 cr

Additional coursework beyond the prescribed courses may be elected from the Spanish offerings of the Department to a maximum of 45 credits.

Students transferring to the College of Arts and Sciences who wish to major in Spanish must make individual arrangements with the Department Chairperson regarding satisfaction of major and collateral course requirements.

Minor Requirements**French**

A minor area of study consists of 18-24 credits with at least six credits at the 300 or 400 levels. Beginning courses in French at the 100 level may not be credited to the French minor.

Greek

A minor area of studies in Greek consists of 18 semester credits of coursework and must include the following 53.101,102 Beginning Greek I and II, 53.301,302 Greek Classics, and 53.303,304 Selected Greek Authors. Unlike other modern languages, Greek has enjoyed a continuous tradition since antiquity and no break, such as that between Latin and the Romance languages, separates the language of the ancients from the moderns. Educated Greek speakers have always had present in their minds the whole of the language up to their own time. Hence, courses for the Greek minor include literature from all periods-from Homer and Plato to Kazantzakis.

Spanish

A minor in Spanish consists of 18-24 credits with at least six credits at the 300 or 400 levels. Beginning courses in Spanish at the 100 level may not be credited to the Spanish minor. Students who are interested in the application of Spanish to the health professions should take 54.313 Fieldwork in the Spanish Community.

Related Minors

Several interdisciplinary minors related to the study of language are available, including German Studies, Italian Studies, Latin American Studies, and Film Studies. These are described under the heading "Interdisciplinary Minors" at the end of the College of Arts and Sciences section of this catalogue.

Course of Study**General Option**

For students entering the University in Fall 1993 and subsequently

Freshman Year**Fall Semester**

42.101	College Writing I (Gen Ed)	3
92.	Mathematics** (Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
	Language I Elective	3
	Language II Elective	3

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Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science** (Gen Ed)	3
	Historical Studies (Gen Ed)	3
	Language I Elective	3
	Language II Elective	3
		15

Sophomore Year

Fall Semester

	Language I Elective	3
	Language II Elective	3
	Beh & Soc St (Gen Ed)	3
	Science** (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

300/400	Language I Elective	3
	Language II Elective	3
	Literature (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Junior Year

Fall Semester

300/400	Language I Elective	3
	Language or Free Elective	3
	Science (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

300/400	Language I Elective	3
	Language or Free Elective	3
	Values, C & C (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Senior Year

Fall Semester

300/400	Language I Elective	3
	Language or Free Elective	3
	Aesthetics (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

300/400	Language I Elective	3
	Free Elective	3
	Free Elective	3

Free Elective	3
Free Elective	3
	15

*Typically, students earn 24 credits in one language and 12 credits in the other as we have outlined here, but they may also elect a program with 18 credits in each language

**Refer to the Academic Policies section in this catalogue for the General Education requirements for mathematics and sciences

Students who transfer to the College and wish to major in Modern Languages must make individual arrangements with the Department Chairperson regarding satisfaction of major and collateral course requirements

Course of Study

French Option

For students entering in Fall 1993 and subsequently

Freshman Year

Fall Semester

42101	College Writing I (Gen Ed)	3
50.221	Reading & Conv in French I	3
92.	Mathematics* (Gen Ed)	3
	Beh & Soc St (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
50.222	Reading & Conv in French II	3
	Science* (Gen Ed)	3
	Historical Studies (Gen Ed)	3
	Free Elective	3
		15

Sophomore Year

Fall Semester

50.246	Adv French Conversation	3
50.	French Literature Elective	3
	Beh & Soc St (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

50.	French Literature Elective	3
50.	French Culture Elective	3

Science* (Gen Ed)	3
Free Elective	3
Free Elective	3
	15

Junior Year

Fall Semester

50.310	French Speaking World	3
50.	French Literature Elective	3
	Literature (Gen Ed)	3
	Science* (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

50.348	Advanced French Comp	3
50.	French Literature Elective	3
	Values, C & C (Gen Ed)	3
	Free Elective	3
	Free Elective	3
		15

Senior Year

Fall Semester

300/400	French Elective	3
50.	French Elective	3
50.	French Elective	3
	Aesthetics (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

300/400	French Elective	3
300/400	French Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

*Refer to the Academic Policies section of this catalogue for the General Education requirements for mathematics and sciences.

Course of Study

Spanish Option

For students entering in Fall 1993 and subsequently

Freshman Year

Fall Semester

42.101	College Writing I (Gen Ed)	3
54.221	Reading & Conv in Spanish I	3
92.	Mathematics* (Gen Ed)	3

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Beh & Soc St (Gen Ed)	3
Free Elective	3
	15

Spring Semester

42.102 College Writing II (Gen Ed)	3
54.222 Reading & Conv in Spanish II	3
Science* (Gen Ed)	3
Historical Studies (Gen Ed)	3
Free Elective	3
	15

Sophomore Year

Fall Semester

54.245 Adv Spanish Conversations	3
54. Spanish Literature Elective	3
Beh & Soc St (Gen Ed)	3
Science* (Gen Ed)	3
Free Elective	3
	15

Spring Semester

54. Spanish Lit Elective	3
54. Spanish Culture Elective	3
Literature (Gen Ed)	3
Free Elective	3
Free Elective	3
	15

Junior Year

Fall Semester

54.350 Intro to Literary Analysis	3
54. Spanish Literature Elective	3
Science* (Gen Ed)	3
Values, C & C (Gen Ed)	3
Free Elective	3
	15

Spring Semester

54.347 Adv Spanish Comp	3
54. Spanish Lit Elective	3
Aesthetics (Gen Ed)	3
Free Elective	3
Free Elective	3
	15

Senior Year

Fall Semester

300/400 Spanish Elective	3
54. Spanish Elective	3
54. Spanish Elective	3
Free Elective	3
Free Elective	3
	15

Spring Semester

300/400 Spanish Elective	3
300/400 Spanish Elective	3
Free Elective	3
Free Elective	3
Free Elective	3
	15

*Refer to the Academic Policies section of this catalogue for the General Education requirements for mathematics and sciences.

French Courses (Prefix: 50)

50.101 Beginning French I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes are available for laboratory use. Students who have had more than one year of French at the secondary level may not earn credit for this course. 3 cr

50.102 Beginning French II*

A continuation of 50.101, which is a prerequisite. 3 cr

50.114 French for Business and International Management II

A continuation of 50.101 with a reading emphasis, presenting to Business and Management concentrators and others, by means of a cultural comparison between the French and the American worlds, the terminology and practices of the Francophone business world, particularly in the domains of accounting, banking, management and legal organization. 3 cr

50.211 Intermediate Conversational French I*

Review of basic grammatical structures and idiomatic patterns with emphasis upon increased proficiency in oral expression and aural comprehension. This course is intended for students who have completed two years of high school French, preferably during their junior and senior years, for students who have completed 50.102, and/or for students who are unqualified for the 50.221,222 sequence. 3 cr

50.212 Intermediate Conversational French II*

A continuation of 50.211, which is a prerequisite, with emphasis upon continued comprehension and conversational skills. 3 cr

50.221 Reading and Conversing in French I

Emphasis is upon development of reading and conversational skills, selected contemporary works provide the basis for developing conversational comprehension and composition skills. This course is intended for students who have a solid foundation in the French language which has been gained from at least three years of high school study immediately prior to admission to the University. 3 cr

50.222 Reading and Conversing in French II

A continuation of 50.221 with emphasis on continued development of reading and conversational skills. Prerequisite: 50.221 3 cr

50.244 Advanced French Grammar and Syntax

A systematic study of grammatical and syntactical structures. Review of more advanced structures. 3 cr

50.246 Advanced French Conversation

Advanced oral practice in rapid and idiomatic speech. Topics of contemporary significance are selected from contemporary prose. 3 cr

50.301 Survey of French Literature I

A survey of French literature based on the history and civilization of France from the Middle Ages to 1800. 3 cr

50.302 Survey of French Literature II

A survey of French literature based on the history and civilization of France from 1800 to the present. 3 cr

50.310 The French-Speaking World

Designed for prospective majors and minors in French as well as for those who have completed four years of high school or two years of college French. The course examines similarities and differences in the ethos of nations of the French-speaking world and in the life-styles of the individuals and groups that make them up. Conducted in French. Garreau 3 cr

50.320 Special Topics in French Studies

A limited topic of special interest in culture, civilization, or literature. May be taught in English or in French. Course content and approach varies, depending on instructor. The Department posts and distributes detailed course descriptions

each semester, and students are urged to use this information in making their selections. 3 cr

50.340 Contemporary French Cinema

A critical appreciation of contemporary French cinema (1985-1995) aiming at sorting out its eclecticism and focusing on the following aspects: 1. The war film and national identity; 2. Representations of sexuality and women filmmakers; 3. The polar and the cinema du look; 4. Filming the arts and the heritage genre. Garreau 3 cr

50.348 Advanced French Composition

Designed to impart proficiency in written French through regular exercises in free composition; analysis of literary texts. 3 cr

50.372 Applied Linguistics

Linguistic analysis of French phonology, morphology and syntax, and a comparison of the structures of French and English. Required for perspective teachers of French at the elementary and secondary school levels. 3 cr

50.376 French Cinema and Society

Covers the dramatic presentation French society gives of itself during the period of profound social and economic change, from the New Wave and the May 68 events to today's younger generation facing an uncertain tomorrow. Each screening (in French with subtitles) is preceded by an introduction placing the film in its historical context. In English. 3 cr

50.378 Women in French Cinema

Focuses on the way French film makers (male, and more recently female) have been portraying women in their films. Carefully selected French films with English subtitles are used to show the evolution that has taken place from *Carne* and *Renoir's* poetic realism to the present. Selected readings are also used to underscore various themes, such as how women have been represented in these films. In English. 3 cr

50.401 Selected Authors

An intensive study of works by several French authors. 3 cr

50.432 The Nouveau Roman

An examination of the techniques and procedures of French literature of the 50's and 60's with particular reference to Beckett, Butor, Robbe-Grillet, Sarraute, and Simon. Conducted in French. Prerequisite: permission of instructor 3 cr

50.442 Theatre and Anti-Theatre

The 20th century French Theatre considered as an experimentation in new dramatic forms and as a metaphorical expression of a new vision of life. Plays from major writers (Cela, Giraudoux, Anouilh, Sartre, Camus, Beckett, Genet, and Ionesco) are analyzed. Conducted in French. Prerequisite: permission of instructor 3 cr

50.454 Techniques of Literary Analysis

Thematic and linguistic analysis of major French prose and poetry of the 19th and 20th centuries. Prerequisite: French concentrators with junior or senior status and others with permission of instructor. Conducted in French. 3 cr

50.456 French Translation Seminar

A study of the theory and practice of translation aimed at developing translation skills. Material used is taken from literary works as well as newspapers and magazines. This course is intended for students with good command of the language. Open to French concentrators and others by permission of instructor. 3 cr

Directed Studies

Directed Studies are available only to French or modern language majors and may be elected provided that 1) the material to be covered is not available in any French course offered during the semester in which directed study is contemplated, 2) instructors are willing to undertake a directed study, and 3) no more than nine credits in the major field are acquired in directed study courses.

50.491 Directed Studies in French Literature

Individual research projects in French literature. Students, through regular and frequent consultation with their instructor, develop a course of directed study in French literature and define a problem for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor 3 cr

50.492 Directed Study in Composition

Students, through regular and frequent consultation with their instructor, pursue a special program of composition or creative expression.

Prerequisite: permission of instructor 3 cr

50.495 Advanced Tutorial in French

A program of directed study which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate a new problem. The purpose of the course is to sharpen and refine techniques for scholarly research, presentation and creative expression. Prerequisites: demonstrated proficiency in an area selected for directed study and permission of instructor 3 cr

Practicum

50.496 Practicum Experience

A program of on-campus and/or off-campus experiences (for French and Modern Language Majors only). Specific requirements vary depending upon Department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated for a maximum of nine credits. Students are graded "satisfactory" or "unsatisfactory." The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson

German Courses (Prefix: 51)

51.101 Beginning German I*

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes are available for laboratory use. Students who have completed more than one year of German at the secondary level may not earn credit for this course. 3 cr

51.102 Beginning German II*

A continuation of 51.101 which is a prerequisite. 3 cr

51.113 Scientific German I

Introductory course designed for students who wish to acquire facility in translating

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scientific material from German to English. Introduction to fundamentals of grammar, problems of syntax and idioms with emphasis on scientific terminology. 3 cr

51.114 Scientific German II

A continuation of 51.113 which is a prerequisite. 3 cr

51.211 Intermediate German I*

A review of German grammar and syntax with emphasis upon increased proficiency in reading, aural comprehension and oral expression. This course is intended for students who have completed two years of high school German, preferably during their junior and senior years, or 51.102. 3 cr

51.212 Intermediate German II*

A continuation of 51.211 which is a prerequisite with emphasis upon continued development of comprehension and conversational skills. 3 cr

Directed Studies

Directed studies are available only to Modern Language majors and may be elected provided that 1) the material to be covered is not available in any German course offered during the semester in which the directed study is contemplated, 2) instructors are willing to undertake a directed study, and 3) no more than nine credits of the modern language major are acquired in directed study courses.

51.491 Directed Study in German Literature

Individual research projects for modern languages. Students through regular and frequent consultation with their instructor develop a course of directed study in German literature and define a problem for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor 3 cr

51.492 Directed Study in German Composition

Individual research projects for Modern Language majors. Students through regular and frequent consultation with their instructor pursue a special problem of composition or creative expression. Prerequisite: permission of instructor 3 cr

51.495 Advanced Tutorial in German

A program of directed study which affords Modern Language majors an additional opportunity to pursue a previously explored topic in greater depth or to initiate an additional topic. The purpose of this tutorial is to sharpen and refine techniques of scholarly research, presentation and creative expression. Prerequisite: demonstrated proficiency in an area selected for directed study and permission of instructor 3 cr

Practicum**51.496 Practicum Experience**

A program of on-campus and/or off-campus experiences (for modern language majors only) which are developed by the student in consultation with a member of the German faculty. Specific requirements vary depending upon the nature of the program undertaken by the student. The intent of the practicum is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the modern language concentration. May be repeated for a maximum of nine credits in practicum courses. Students are graded "satisfactory" or "unsatisfactory." The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson 3 cr

**Greek Courses
(Prefix: 55)****55.101 Beginning Greek I***

No previous knowledge of Greek required. The aims are basic oral expression, aural comprehension, and elementary reading and writing in modern and ancient Greek. Bentas 3 cr

55.102 Beginning Greek II*

Continuation of 55.101 with readings in Greek prose and poetry. The course provides a foundation for advanced study in modern or classical Greek. Prerequisites: 55.101 or equivalent and permission of instructor Bentas 3 cr

55.211 Intermediate Greek I*

Review and development of audio-lingual skill, writing and reading in Greek, fol-

lowed by the reading of Greek texts from the classical, Byzantine and modern periods. Prerequisites: 55.101, 55.102 or equivalent and permission of instructor Bentas 3 cr

55.212 Intermediate Greek II*

Continuation of 55.211. Bentas 3 cr

55.301 Greek Classics I

Concentrated readings of Homer, Herodotus, Xenophon, Plato and the dramatists. Prerequisites: 55.212 or equivalent and permission of instructor Bentas 3 cr

55.302 Greek Classics II

Continuation of 55.301. Prerequisites: 55.212 or equivalent and permission of instructor Bentas 3 cr

55.303 Selected Greek Authors

Intensive study of a few works of an author not previously studied. May be repeated for credit with approval of instructor. Bentas 3 cr

55.310 Special Topics in Greek Studies

A limited topic of special interest in culture, civilization, or literature. May be taught in English or Greek. Course content and approach varies depending on instructor. The Department posts and distributes a detailed course description each semester, and students are urged to use this information in making their selections. 3 cr

The following courses are conducted in English and do not satisfy any language requirement.

55.251 Great Books of Ancient Greece

A study in the meaning and importance of the Greek masterpieces, which are read in the best translations available. (Subject to demand of classical civilization minors.) Bentas 3 cr

55.252 Great Books of Ancient Greece

Continuation of 55.251. Subject to demand of classical civilization minors. Bentas 3 cr

55.351 Classical Drama

Group readings of great plays; discussion of their meaning and importance; lectures on the Greek Theatre; the origins of

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tragedy and comedy, the nature of drama, and the special achievements of each dramatist. Prerequisite: permission of instructor (Subject to demand of classical civilization minors.) Bentas 3 cr

55.451 Greek Thought

The Greek view of man and nature as revealed in myth, philosophy, science, history, art, and literature, and their relation to the modern age. (Subject to demand of classical civilization minors.) Prerequisite: permission of instructor Bentas 3 cr

**Italian Courses
(Prefix: 52)****52.101 Beginning Italian I***

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes are available for laboratory use. Students who completed more than one year of Italian at the secondary level may not earn credit for this course. 3 cr

52.102 Beginning Italian II*

A continuation of 52.101, which is a prerequisite. 3 cr

52.211 Intermediate Italian I*

A review of Italian grammar and syntax with emphasis on increased proficiency in reading, aural comprehension, and oral expression. This course is intended for students who have completed two years of high school Italian, preferably during their junior and senior years, or 52.102. 3 cr

52.212 Intermediate Italian II*

A continuation of 52.211 which is a prerequisite with emphasis upon continued development of comprehension and conversational skills. 3 cr

52.310 Special Topics in Italian Studies

A limited topic of special interest in culture, civilization, or literature. May be taught in English or Italian. Course content and approach varies depending on instructor. The Department posts and distributes a detailed course description each semester, and students are urged to use this information in making their selections. 3 cr

The following courses are conducted in English, do not satisfy any language requirement and cannot be counted as part of the Modern Language major.

52.325 Italian American Literature and Culture

Discusses the most prominent authors and works of Italian American Literature as they, by using the ethnic setting are able to convey universal human concerns and themes. Conducted in English. Aste 3 cr

52.330 Italian Women Writers

Studies women writers of Italy by giving attention to the genres of narrative, poetry, theater and autobiography. Authors are selected according to their impact on issues affecting women, gender studies, feminism, avantgarde, modernism, social relations and psychological discourse. Conducted in English. Aste 3 cr

52.335 Cinema and the Italian Americans

A course looking at the ways in which film addresses issues of ethnicity and its representation in the multi-ethnic and multi-cultural memory of American life. This will be an interdisciplinary course focusing on the relentless portrayal in the news and entertainment industries of Italian Americans. It will shed light on the contributions of this ethnic group by analyzing the negative and positive stereotypes through films. Aste 3 cr

52.371 Dante's Divine Comedy

A detailed study of the Divine comedy. Consideration is given to the influence of Dante's minor works, to the unity of the poem as a synthesis of Dante's new life, and to Dante's views of the world and history. Conducted in English. Aste 3 cr

52.373 Italian Humanism

A study of the waning of the Middle Ages and the dawning of the Renaissance as seen through the work of Petrarch and Boccaccio. Emphasis is on the study of sources and the influence of Petrarch and Boccaccio upon the literatures of western Europe. Conducted in English. Aste 3 cr

52.374 Classics of Italian Cinema

This course, through a series of classic Italian films, internationally recognized, will present how the style is not only something which comes from within the director reflecting that most intriguing of all subjects: the personality of the director,

but also the film's influence upon American productions. Aste 3 cr

52.376 Pirandello: His Theater and Influence

A course devoted to the major works of Pirandello which have established his reputation as an entertainer and a social critic with special emphasis upon his notion of appearance vs. reality and his influence upon contemporary French drama. Conducted in English. Aste 3 cr

52.378 Italian Cinema and Culture

A guide to contemporary Italian studies through literary and cultural approaches. The works of central figures in contemporary Italian letters are examined in view of their impact on Italian life. Emphasis is given to poets, novelists, the new cinema, the influences of existentialism, and the impact of America on Italian literature. Conducted in English. Aste 3 cr

52.380 Italian Cinema: Directors and Themes

A study of Italian film history and its accomplishment by exploring the relationship of cinema to socio-political, economic, cultural and literary events. The course will discuss in depth either a) one or two major and well known directors; b) a major thematic and stylistic division in a century of cinematic creativity. Aste 3 cr

Directed Studies

Directed studies are available only to Modern Language majors and may be elected provided that 1) the material to be covered is not available in any Italian course offered during the semester in which a directed study is contemplated, 2) instructors are willing to undertake a directed study, and 3) no more than nine credits of the Modern Language major are acquired in directed study courses.

52.491 Directed Study in Italian Literature

Individual research projects for modern language majors. Students, through regular and frequent consultation with their instructor, develop a course of directed study in Italian literature and define a subject for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor 3 cr

COLLEGE OF ARTS AND SCIENCES*Department of Languages***52.492 Directed Study in Italian Composition**

Individual research projects for modern language majors. Students, through regular and frequent consultation with their instructor, pursue a special topic of composition or creative expression. Prerequisite: permission of instructor 3 cr

52.495 Advanced Tutorial in Italian

A program of directed study which affords Modern Language majors with an additional opportunity to pursue a previously explored topic in greater depth or to initiate additional ones. Prerequisites: demonstrated proficiency in an area selected for directed study and permission of instructor 3 cr

Practicum**52.496 Practicum Experience**

A program of on-campus and/or off-campus experiences (for Modern Language majors only) which are developed by the student in consultation with a member of the Italian staff. Specific requirements vary depending upon the nature of the program undertaken by the student. The intent of the practicum is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skill which are appropriate to the modern language concentration. May be repeated for a maximum of nine credits in the practicum courses. Students are graded "satisfactory" or "unsatisfactory." The practicum may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson 3 cr

**Latin Courses
(Prefix: 56)****56.101 Beginning Latin I***

A course for beginners and for students wishing to review the elements of Latin and to acquire, thereby, an ability to read selected passages from Latin authors. 3 cr

56.102 Beginning Latin II*

Continuation of 56.101 with special attention devoted to the translation, analysis, and class discussion of selected passages from Latin authors illustrating the life, culture, and contribution of ancient Rome to the modern world. 3 cr

56.211 Intermediate Latin I*

Readings from Latin prose and poetry with special attention to the works of such authors as Cicero and Virgil. Prerequisites: 56.101, 102 3 cr

56.212 Intermediate Latin II*

Continuation of 56.211. 3 cr

56.301 Latin Classics I

Concentrated readings in such authors as Livy, Tacitus, Horace, Juvenal, Catullus, Ovid, and medieval Latin writers. Prerequisites: 56.101, 56.102, or four years of high school Latin Bentas 3 cr

56.302 Latin Classics II

Continuation of 56.301. Bentas 3 cr

56.303 Selected Latin Authors

Intensive study of a few works by an author not previously studied. May be repeated for credit with approval of instructor. Bentas 3 cr

56.310 Special Topics in Latin Studies

A limited topic of special interest in culture, civilization, or literature. May be taught in English or in Latin. Course content and approach vary depending on instructor. The Department will posts and distribute a detailed course description when appropriate. 3 cr

56.352 Classical Drama

Continuation of 55.351 with concentration on the Roman dramatists. Prerequisite: permission of instructor (Subject to demand of classical civilization minors.) Bentas 3 cr

56.451 The Roman Mind

The Roman view of man and nature as revealed in law, government, social institutions, legend and religion, and their relation to the modern world. Prerequisite: permission of instructor. (Subject to demand of classical civilization minors.) Bentas 3 cr

**Spanish Courses
(Prefix: 54)****54.101 Beginning Spanish I***

Development of fundamental skills in oral expression, aural comprehension, reading and writing. Tapes are available for laboratory use. Students who completed more than one year of Spanish at the secondary level may not earn credit for this course. 3 cr

54.102 Beginning Spanish II*

A continuation of 54.101 which is a prerequisite. 3 cr

54.103 Conversational Spanish for Health Professions

Fundamental skills in conversation for the health professions (semi-technical functional vocabulary, idiomatic expressions used by patients and doctors, and situational phrases for the health professions) with special emphasis upon those cultural and physiological characteristics of the Spanish speaking world. 3 cr

54.114 Spanish for Business and International Management

A continuation of 54.101 for business and management concentrators and others, with a reading emphasis, showing cultural comparisons between the Hispanic and the American worlds in the terminology and practices of the Hispanic business world, particularly in the domains of accounting, banking, management and legal organization. 3 cr

54.211 Intermediate Conversational Spanish I*

A review of Spanish grammar and syntax with emphasis upon increased proficiency in aural comprehension and oral expression. This course is intended for students who completed two years of high school Spanish, preferably during their junior and senior years, for students who completed 54.102, and for students who are unqualified for the 221.222 sequence. 3 cr

54.212 Intermediate Conversational Spanish II*

A continuation of 54.211, which is a prerequisite, with emphasis upon continued development of comprehension and conversational skills. Required of Spanish concentrators 3 cr

54.213 Intermediate Conversational Spanish III*

Designed for Criminal Justice majors, this course may replace 54.212, the second portion of the intermediate sequence. Continued development of comprehension and conversational skills are emphasized. Students work with relevant technical vocabulary and highly idiomatic "street" language. Cultural information emphasizes characteristics of the Spanish-speaking population in the United States. 3 cr

54.221 Reading and Conversing in Spanish I

Basic emphasis is upon Spanish grammar review and the development of reading and conversational skills. Selected contemporary works provide the basis for developing conversational comprehension and conversational and composition skills. This course is intended for students with a solid foundation in the Spanish language which has been gained from at least three years of high school study immediately prior to admission to the University. 3 cr

54.222 Reading and Conversing in Spanish II

A continuation of 54.221 which is a prerequisite with emphasis on continued development of reading and conversational skills. Required of Spanish concentrators. 3 cr

54.234 Adv Spanish Grammar & Syntax

A systematic study of complex grammatical and syntactical problems. Review of more advanced problems. 3 cr

54.245 Advanced Spanish Conversation

Advanced oral fluency in rapid, idiomatic speech. Topics of contemporary significance are selected from contemporary prose. Required of Spanish concentrators. 3 cr

54.254 Topics in Conversational Spanish

Discussion of a wide spectrum of contemporary topics with the object of continuing to develop facility and accuracy of expression. Prerequisite: advanced level proficiency 3 cr

54.301 Intro to Spanish Literature

The history of Spain's literature studied in its general trends and through its major writers revealing the complicated series of interactions, conflict and influences which have molded the unique character of the nation. Conducted in Spanish. Prerequisite: permission of instructor 3 cr

54.302 Intro to Latin American Lit

A study of the major writers of Latin America from the indigenist literature to the modernist period. The authors and their works are placed in their historical, sociological, and literary perspective, thus introducing students to the Latin American world. Conducted in Spanish. Prerequisite: permission of instructor required 3 cr

54.310 Spanish Civilization and Culture

Considers Spanish culture and civilization up to the present. Through audiovisual aids, current newspapers and selected readings the student explores the Spanish way of being, thinking, and living. Emphasis is on the main contributions of Spain to the Western world. 3 cr

54.313 Fieldwork in the Spanish Community

Individual assignments under the sponsorship of local service agencies servicing the Spanish speaking community involving individual family and group contact. Written and oral reports in Spanish. Prerequisite or corequisite: 54.212 or equivalent 3 cr

54.315 Latin American Civilization and Culture

Considers significant intellectual, artistic, historical and socio-political aspects of Latin American from the beginning of its history. Through audiovisual aids and selected readings, the student explores the Latin American way of being and expressing. 3 cr

54.320 Special Topics in Spanish Studies

A limited topic of special interest in culture, civilization, or literature. May be taught in English or in Spanish. Course content and approach vary depending on instructor. The Department posts and distributes detailed course descriptions each semester, and students are urged to use this information in making their selections. Prerequisite: permission of instructor required 3 cr

54.330 Spanish and Latin-American Women Writers

Studies women writers of the Spanish-speaking world from the XVI Century to the present. Emphasis is given to their contribution to the development of Spanish literature and culture as well as their vision of the world and their concerns for the rights of women. Among the writers studied are Santa Teresa de Jesus, Sor Juana Ines de la Cruz, Emilia Pardo Bazan, Carmen de Burgos, Silvina Ocampo, Elena Garro, Armonia Somers, Marta Lynch and Victoria Ocampo. Conducted in Spanish. Saitz 3 cr

54.347 Advanced Spanish Composition

Designed to help the mature language student recognize and interpret a variety of literary styles. Also designed to develop self-expression and facility in prose writing. Required of Spanish concentrators. 3 cr

54.350 Intro to Literary Analysis

Focuses on acquiring the technical vocabulary, concepts and methods of literary criticism. Through the analysis of selected Spanish literary works, the student gains an understanding of the different literary genres as well as a knowledge of their structures and artistic qualities. Required for all Spanish concentrators. 3 cr

54.372 Applied Linguistics

Linguistics analysis of Spanish phonology, morphology, and syntax with a systematic comparison of the structures of Spanish and English. Required for prospective teachers of Spanish in the elementary and secondary schools. 3 cr

54.401 Selected Authors

An intensive study of works by a few Spanish and/or Latin American authors. 3 cr

54.403 The Golden Age

A study of the development and character of XVIIth century Spanish drama, novel and poetry with special emphasis on Cervantes, Lope de Vega, Calderon and Quevedo. An analytical study of some of the masterpieces from structural and stylistic points of view, taking into consideration their relation to the period and the expression of universal values. Prerequisite: 54.350 or permission of instructor 3 cr

54.404 Cervantes

Study of the works of Cervantes. Complete analysis and readings of either the Don Quijote and/or other works including but not limited to the short stories and the one act plays. Conducted in Spanish. Prerequisite: permission of instructor 3 cr

54.405 The Generation of '98

A critical study of such influential authors as Unamuno, Valle-Inclan, Baroja, Azorin, and Machado. Special emphasis is given to their influence upon the emergence of modern Spain. Prerequisite: 54.350 or permission of instructor 3 cr

COLLEGE OF ARTS AND SCIENCES*Department of Languages***54.407 Spanish Picaresque Novel**

Analysis of representative works of the picaresque genre, its portrait of Spanish society and social criticism. Emphasis is placed on *El Lazarillo de Tormes*, *Guzman de Alfarache*, *El Buscon* and *Riconete y Cortadillo*. Prerequisite: 54.350 or permission of instructor 3 cr

54.409 Twentieth Century Spanish Lit

A study of the famous generation of 1927 and of the major literary trends during and after the Spanish Civil War. Prerequisite: 54.350 or permission of instructor 3 cr

54.410 Realism and the XIX Century Spanish Novel

A study of fundamental aspects of life, thought, land itself and its sense of history as reflected in the literary masterpieces of Valera, Galdos, Alarcon, Pereda and others. An analysis of the literary techniques and fiction of Realism is included. Prerequisite: 54.315 or permission of instructor 3 cr

54.412 Short Story in Latin America

An analytical examination of the thematic and linguistic structures of major Latin American short story writers such as Borges, Cortazar, Marquez, Rulfo. Prerequisite: 54.350 or permission of instructor 3 cr

54.416 The Latin American Novel

The study of the development of the Latin American novel. Three major works (Dotin American short story writers such as Borges, Cortazar, Marquez, Rulfo. Prerequisite: 54.350 or permission of instructor 3 cr

54.450 Twentieth Century Spanish Essay

Spanish essay of the twentieth century considered in the context of changes in modern Spain. Authors include Ortega y Gasset, Lain Entralgo, Marias and Ayala. Conducted in Spanish. Prerequisite: permission of instructor 3 cr

54.451 Nineteenth and Twentieth Century Latin American Essay

Latin American essays of the nineteenth and twentieth century. Among the authors studied are Montalvo, Bolivar, Bello, Rodo, Henriquez Urena, Vasconcelos, Alfonso Reyes and German Arciniegas. 3 cr

54.456 Spanish Translation Seminar

A study of the theory and practice of translation aimed at developing translation skills. Material used is taken from literary works as well as newspapers and magazines. This course is intended for students with a good command of the language. Open to Spanish concentrators and others by permission of instructor 3 cr

Directed Studies

Directed Study are available only to Spanish or Modern Language majors and may be elected provided that 1) the material to be covered is not available in a Spanish course offered during the semester in which a directed study course is contemplated, 2) instructors are willing to undertake a directed study course, and 3) no more than nine credits in the major field are acquired in directed study courses.

54.491 Directed Study in Spanish Lit

Students, through regular and frequent consultation with their instructor, develop a course of directed study in Spanish literature and define a program for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor 3 cr

54.492 Directed Study in Latin American Literature

Students, through regular and frequent consultation with their instructor, develop a course of directed study in Spanish literature and define a program for individual research. The student's findings are presented in a paper of significant proportions. Prerequisite: permission of instructor 3 cr

54.493 Directed Study in Composition

Students, through regular and frequent consultation with their instructor, pursue a special program of composition or creative expression. Prerequisite: permission of instructor 3 cr

54.495 Advanced Tutorial in Spanish

A program of directed study which affords advanced students an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and refine techniques for scholarly research and presentation and for cre-

ative expression. Prerequisites: demonstrated proficiency in an area selected for directed study and permission of instructor 3 cr

Practicum**54.496 Practicum Experience**

A program of on-campus and/or off-campus experiences for Spanish or Modern Language majors only. Specific requirements vary depending upon Department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated for a maximum of nine credits. Students are graded "satisfactory" or "unsatisfactory." The practicum experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson. 3 cr.

*Beginning and intermediate language courses at the 101,102 and 211,212 levels must be elected for two consecutive semesters and in the prescribed sequence. College credit may not be granted for one semester of such courses unless exception is permitted by the Chairperson of the Department of Languages on the basis of placement in a more advanced language course.

Legal Studies

William J. Burke, Coordinator

Professors: William J. Burke

Associate Professors: Michael Jones,
Russell Karl

Most of the nation's law schools reject the idea of a rigid pre-law curriculum as a means of preparing for entrance into law school. The undergraduate pre-law student is actually working toward two different objectives: vigorous academic preparation for law school and an undergraduate education that will complement the law degree once obtained.

The type of undergraduate degree pursued may depend on the type of law in which you intend to specialize. For example, if you want to become a tax attorney, you might concentrate in accounting and economics. If copyright law interests you, an undergraduate degree in music or art would be beneficial. Those students interested in law school as a prelude to government service or politics may want to pursue an undergraduate degree in political science. Many students do not have a particular field of law identified prior to entering college. For such students, a broad liberal arts preparation is important. All pre-law students should be aware that communications skills are very important, and for this reason, courses in English, speech, and foreign languages should be considered.

Legal Studies Minor

The Legal Studies Minor is a program offered by the Legal Studies Department that allows the student to gain a valuable insight into substantive law courses. Many of the Legal Studies courses serve as previews to the courses offered in law schools.

In order to earn a Legal Studies Minor, the student must file with the Office of Enrollment Services, an Academic Petition approved by the Legal Studies Coordinator. A Legal Studies Minor consists of a minimum of 18 credits chosen from the Legal Studies courses (41 prefix). Note that only one of the introductory courses (41.261, 41.262) may be credited toward the minor.

Professors of Legal Studies, in their advisory roles, will tailor the student's Legal Studies Minor to complement the student's

major. For example, an Accounting major might take the following as his or her Legal Studies courses: Introduction to Business Law, Corporate and Property Law, Law for the CPA and Pre-Law Student, The Legal Environment of Business, Business Planning, and Federal Income Tax Law.

Six of the following courses are required for the Legal Studies Minor. Only one of the introductory courses (41.261, 41.262) may be credited toward the minor. For further information, inquire at the Legal Studies Office in Falmouth 302.

- 41.234 Criminal Law
- 41.261 Introduction to Legal Concepts
- 41.262 Introduction to Business Law
- 41.360 Legal Issues in Racism
- 41.363 Corporate and Property Law
- 41.364 Law for the CPA and Pre-Law Student
- 41.365 The Legal Environment of Business
- 41.366 International Law
- 41.367 Environmental Law
- 41.368 Employment and Labor Law
- 41.369 The Courts and the Constitution
- 41.370 Real Estate Law
- 41.371 Legal Issues in Health Care
- 41.372 Sports & Entertainment Law
- 41.373 Consumer Law
- 41.374 Computers and the Law
- 41.375 Securities Regulation
- 41.376 Family Law
- 41.377 Practice Law for the Individual
- 41.378 Comparative European Community Law
- 41.379 The Relationship of Law, Logic, and Ethics
- 41.380 Marketing's Fifth P-Prosecution and Legal Restriction
- 41.381 Women and the Law
- 41.382 Business Planning
- 41.383 Alternative Dispute Resolution
- 41.384 State and Local Taxation
- 41.385 Immigration Law
- 41.386 Intellectual Property
- 41.387 Legal Research Methods
- 41.390 Litigation
- 41.391 Federal Income Tax Law
- 41.395 Bankruptcy Law
- 41.488 Directed Study in Law
- 41.489 Seminar in Law

Legal Studies Courses (Prefix: 41)

41.234 Criminal Law

This course is a study of substantive criminal law, with emphasis on general principles of criminal culpability, such as the act requirement, the mens rea requirement, and causation. The course will also cover the law of attempted crimes, accomplice liability, and defenses. The elements of specific crimes, such as homicide, burglary, robbery, and larceny will be studied in depth. 3 cr

41.261 Introductory Legal Concepts

An introductory legal course. It is a survey of many specific topics such as product liability, consumer law, intellectual property, and ethics. More importantly the course emphasizes critical legal thinking and human values. 3 cr

41.262 Intro to Business Law

Introduces the student to the fundamentals of criminal and tort law. The main emphasis is on all aspects of contract law including the agreement, consideration, the writing third party rights, illegality, performance, and remedies. Also covered is agency law concerning all situations where one party is working for another in the business world. This course is highly recommended for pre-law students, CPAs and paralegals. 3 cr

41.360 Legal Issues in Racism

A study of racial discrimination in the United States. Emphasis will be placed on relevant constitutional provisions, statutory provisions, and on U. S. Supreme Court cases. 3 cr

41.363 Corporate and Property Law

This course studies the law and its impact on the business world. Partnerships, limited partnerships, and joint ventures are studied at the outset of the course. The main emphasis is on elements of the corporate structure. The last part of the course deals with personal and real property with coverage of wills and trusts. This course is highly recommended for pre-law students, CPAs and paralegals. 3 cr

41.364 Law for the CPA and Pre-Law Student

This course is recommended for the senior level student, especially those students studying for the CPA exam and for those students preparing for law school. The course deals exclusively with the Uniform Commercial Code, including sales, bills,

COLLEGE OF ARTS AND SCIENCES*Legal Studies*

notes, secured interests, and bulk sales. Prerequisite: one prior legal studies course or permission of the instructor 3 cr

41.365 The Legal Environment of Business

This course deals with the manager's role in understanding and determining the firm's relations with government and society. Topics relating to government include the tax and regulatory provisions of local, state and federal agencies. Some of the regulatory provisions studied include provisions governing licensing and mergers. The antitrust laws are also examined. Topics relating to society include the social cost of business, civil rights, business ethics, and problems in ecology. 3 cr

41.366 International Law

This course is recommended at the senior level. Students are introduced to the body of international rules, customs and regulations which are in force between nations. Specific legal issues involving a study of multinational cultural, political, economic and ethnic perspectives are addressed. Topics include human rights, war prevention, foreign policy, tort and criminal liability, business trade practices, and dispute settlement. 3 cr

41.367 Environmental Law

Examines the legal and administrative problems of protecting the quality of the human environment. Federal and state legislation on environmental policy is studied. "Public interest" litigation as a supplement to the enforcement of environmental law is discussed. Places emphasis on the law as a means of protecting the environment. 3 cr

41.368 Employment and Labor Law

Discusses legislative and judicial decisions and the Department of Labor's administrative rulings relative to the management-labor process. Reviews the sources of labor law and employer and union unfair labor practices. Emphasizes the Occupational Safety Health Act, the Civil Rights Act, the Equal Opportunity Act, and the National Labor Relations Act. 3 cr

41.369 The Courts and the Constitution

Focuses on the separation of powers of the national government and the limitation of national power to preserve a degree of autonomy in the states. These dispersions of power which have guaranteed fundamental individual liberties are examined by reading leading U.S. Supreme Court cases. Students will explore how their free-

doms to make moral choices are affected by the law of the constitution. 3 cr

41.370 Real Estate Law

Includes in its treatment contracts for the sale of real estate, deeds, title examinations, security for real estate transactions, methods and problems of co-ownership, zoning ordinances, brokerage contracts, leases and landlord and tenant rights and liabilities. 3 cr

41.371 Legal Issues in Health Care

This course examines the law of private and public health care. The rights and responsibilities of the health care professional to patient and society are investigated. Current health, political, economic, legal and societal issues affecting government, individuals, health care providers and insurance carriers are reviewed. 3 cr

41.372 Sport & Entertainment Law

This course explores the legal issues that arise in the sports and entertainment industry. In the amateur sport setting the legal relationships between athletes, coaches, schools and athletic associations are examined in depth. Contract law, federal labor and anti-trust regulations are reviewed to define the rights and responsibilities of the various participants in the professional sports arena. 3 cr

41.373 Consumer Law

Acquaints the student with current federal and state consumer protection statutes. Deals with individual consumer problems by discussing deceptive advertising and the legal effect of warranties. Delves into the law pertaining to consumer credit including unfair debt collection tactics. Investigates insurance law as it affects consumers and surveys the law protecting incompetent consumers. Examines the legal remedies available to consumers including the consumer class action. 3 cr

41.374 Computers and the Law

Provides an introduction into the common areas of the law related to the acquisition and use of computer goods and services. Deals with computers and constitutionally-protected private rights, computer crimes, computer torts and contracts. Methods of protecting software development such as copyright, patent, trade secrets and program licensing are explained and discussed. Introduces legal research using a computer. 3 cr

41.375 Securities Regulation

Discusses within a legal context the roles and ethical considerations of corporate management, the underwriter, CPA, directors and "insiders." The nature of a security, the registration process, exemptions from registration and civil liability are explained within the Securities Acts and regulations promulgated thereunder by the Securities and Exchange Commission. 3 cr

41.376 Family Law

The critical family law issues facing society today are studied. Subject matter examined includes the law of marriage, custody, adoption, divorce, child support, juveniles, right to die, fetal tissue transfer to prolong the life of another, reproduction control and surrogate parenting. This course is taught from a legal and human values perspective. 3 cr

41.377 Practice Law for the Individual

Survey course of the law for the student taking only one law course for a practical purpose. It will focus on common problems that are encountered in the real world such as landlord tenant relationships, buying your first home, wills, trusts, insurance contracts, and simple contracts as well as bankruptcy and divorce. 3 cr

41.378 Comparative European Community Law

This course deals with the relationship between European Community law and the law of the United States; the operation and impact of community law in the United States; and the role of the European courts in interpreting community law. International treaties, laws, and regulations affecting the free movement of people, goods and services are traced. 3 cr

41.379 The Relationship of Law, Logic and Ethics

This course examines the impact of ethical viewpoints on the structure of legal doctrines. It stresses the fact that the study of law is a study of ethics as well as logic. 3 cr

41.380 Marketing's Fifth P - Prosecution and Legal Restriction

Increasing legal prosecution and Government intervention are influencing marketing decision making. As law becomes ever more intrusive, knowing how to avoid problems and how to make the system work for the company can pay off handsomely. The course will cover such

Legal Studies

topics as sales promotion tactics, the do's and don'ts of advertising, Antitrust laws, postal restrictions, product trademarks, taxes and restrictions, franchises, warranties, guarantees and U.S. restrictions on doing business abroad. 3 cr

41.381 Women and the Law

Covers issues that particularly affect women. Topics include: sex discrimination, sexual harassment, marriage, divorce, reproductive control, surrogate motherhood, and child custody. 3 cr

41.382 Business Planning

General survey of the basic factors to be considered in the organization, financing, operation and liquidation of the small business venture. These factors will be examined within a choice of business entity frameworks. Proprietorships, partnerships, business trusts, close corporations and professional corporations will be covered. There will be an emphasis on federal taxation of these entities. 3 cr

41.383 Alternative Dispute Resolution

The traditional trial is becoming increasingly rare in modern civil litigation; the large majority of disputes are resolved by other techniques. This course will examine alternative methods of dispute resolution such as negotiation, mediation, arbitration and the mini trial. 3 cr

41.384 State and Local Taxation

The development of the state and local tax systems with particular emphasis on recent Massachusetts changes in real and personal property taxation as well as business taxes; consideration of the uniformity and equality requirements of both state and federal constitutions; and emphasis on the assessment and collection of taxes, and the taxpayer's legal remedies concerning tax abatements. 3 cr

41.385 Immigration Law

A study of the immigration, nationality, and naturalization laws of the United States. The topics discussed are: the immigrant selection system, the issuance of immigrant and non-immigrant visas; grounds of excludability of aliens and waiver of excludability; grounds for deportation of aliens and relief from deportation; and change of status within the United States including legalization, refugee and asylum status. 3 cr

41.386 Intellectual Property

A survey of the law of the protection of ideas, trade secrets, inventions, artistic creations, and reputation. The course will briefly review the bases for patent, trademark, copyright and trade secret protection, the distinction between the various forms of intellectual property, and the statutory and common law methods of enforcing rights. 3 cr

41.387 Legal Research Methods

This course is designed to introduce the student to the fundamentals of legal research and writing. The student will gain hands-on experience in legal research and in the reporting of such research in case briefs and memoranda. Emphasis will be placed on the case law on the case law and statutory law of the Commonwealth of Massachusetts. 3 cr

41.390 Litigation

Examines the practices and procedures involved in the litigation process. Topics include: legal research, courts and jurisdictions, evidence, discovery, pleadings, motions, depositions, trials and appeals, and the federal rules of procedure. 3 cr

41.391 Federal Income Tax Law

The course is an introduction to the fundamentals of federal income tax law. Students will become familiar with the provisions of the Internal Revenue Code dealing with the identification of income subject to taxation, and deductions. 3 cr

41.395 Bankruptcy Law

This course will involve itself with the study of Federal and State Statutes concerning credit lending, business bankruptcy, individual bankruptcy, protective trust devices, and credit report implications of bankruptcy. 3 cr

41.488 Directed Study in Law

Permits superior students to engage in specialized study. Prerequisite: permission of Legal Studies Coordinator. 3 cr

41.489 Seminar in Law

Provides opportunity for small groups of advanced students to study selected topics. Prerequisite: permission of Legal Studies Coordinator. 3 cr

Graduate Courses in the Legal Studies Department**41.602 Law and Society**

An introduction to the study of law and the legal environment in which it functions. This course covers the elements of macro-law (governmental agencies and law) as well as micro-law (private historical law). Topics include product liability, employment law, business ethics, contract law, security regulation, business organization, and the uniform commercial code section that has been internationalized. 3 cr

41.610 The Regulatory Environment

Strictly focuses on the law of government regulation of business activity. Topics include administrative law, discrimination in the work place, mandating universal health care, drug testing and rights to privacy, protecting corporate secrets, regulation of markets, criminal law in the boardroom and bankruptcy. A case approach is used. Prerequisite: 66.602 3 cr

41.620 Property Law

The general principles of the law of property and legal requirements for acquiring and transforming different property interests. Leases, bailments, cooperatives, real estate agents, condominium law, and land use regulation. Trust and wills are emphasized. 3 cr

41.670 International Law

Recommended at the senior level. Students are introduced to the body of international rules, customs and regulations which are in force between nations. Specific legal issues involving a study of multinational cultural, political, economic and ethnic perspectives are addressed. Topics covered include human rights, war prevention, foreign policy, tort and criminal liability, business trade practices, and dispute settlement. Prerequisite: 66.602 3 cr

41.680 Constitutional Law

Focuses on the separation of powers of the national government and the limitation of national power to preserve a degree of autonomy in the states. These dispersions of power which have guaranteed fundamental individual liberties are examined by reading leading U.S. Supreme Court cases. Students will explore how their freedoms to make moral choices are affected by the law of the constitution. 3 cr

COLLEGE OF ARTS AND SCIENCES*Department of Mathematical Sciences***41.685 Employment and Labor Law**

Examines sources of labor. Discusses legislative and judicial decisions and the Department of Labor's administrative ruling relevant to the management labor process. Reviews the sources of labor law and employer and union unfair labor practices. Emphasizes the Occupational Safety Health Act, the Civil Rights Act, the Equal Employment Opportunity Act and the National Labor Relations Act. 3 cr

41.690 Environmental Law

Examines: 1) the new environmental regulating law and policies; 2) joint federal-state enforcement; 3) international environmental law developments; 4) significant judicial and administrative cases; and 5) integrating environmental consideration and costs into planning decisions. 3 cr

41.695 Current Topics in Law

Selected topics having current and future impact on the law. Prerequisite: 66.602 3 cr

Department of Mathematical Sciences

(For up-to-date information visit the Mathematical Sciences Web page at <http://www.uml.edu/Dept/Math>.)

Kenneth M. Levasseur, Chairperson

Professors: Shimshon Berkovits, Charles L. Byrne, Alan W. Doerr,

M. Brendan Fleming (Emeritus), Enrique Gonzalez-Velasco, Lee K. Jones, Gerald Kaiser, Kenneth M. Levasseur, Yuly Makovoz, Gerald A. Paquette (Emeritus), Vidhu Prasad, Mary Beth Ruskai, Alexander Samarov, Bernard Shapiro (Emeritus), Virginia S. Taylor (Emerita), I. Jacob Weinberg, Yong Q. Yin

Associate Professors: Ronald I. Brent, Pasquale Condo (Emeritus), James Graham-Eagle, Ann Marie Hurley, Alan Kaplan, Thomas G. Kudzma, Rida M. Mirie, Guntram B. Mueller, Alexander A. Olsen, Stephen A. Pennell, Shelley L. Rasmussen, Ashot Shahinian, Stanley L. Spiegel, Marvin E. Stick, Joyce W. Williams (Emerita)

Assistant Professors: Louis F. Rossi, Richard E. Winslow

Long recognized as a fundamental organizing structure of mind and universe, mathematics is a key discipline in the integration of technology and the humanities. The Department of Mathematical Sciences strives to provide students at all levels of instruction from the nontechnical major to future mathematics teachers, scientists and engineers to graduate students engaged in original mathematics research an awareness of the universality of mathematics and to give them the necessary tools to use mathematics at an appropriate level.

The Mathematical Sciences Department offers a major in Mathematics which leads to the Bachelor of Science degree. Mathematics majors can earn a general degree, or specialize in a specific area by selecting an option: Applied Mathematics, Actuarial Science, Computers, Statistics, or Teaching.

The Department offers a minor in Mathematics to students majoring in other fields.

Mathematics Major

The major in Mathematics is designed to provide a sequence of courses which acquaint the student with the important concepts underlying the main branches of mathematics. The Mathematics major is offered under requirements of the College of Arts and Sciences for the Bachelor of Science degree. The Mathematics major curriculum exceeds the minimal recommendations of the Committee on the Undergraduate Program in Mathematics of the Mathematical Association of America for college mathematics majors programs.

It provides a valuable background for subsequent graduate study in mathematics, in related disciplines, and in education. It also prepares students for employment in business and industry. Mathematics majors are encouraged to select a field of specialization by the end of the sophomore year. The areas of specialization, or options, are:

Applied Mathematics
Statistics
Computers
Actuarial Mathematics
Teaching

A student may also choose no option and would graduate with simply a bachelor of science degree in mathematics. A student who chooses an option is required to select three courses from an approved list for a particular area. A student who does not choose an option must select three courses from approved lists, but these courses may be chosen for breadth rather than depth.

Elementary and Secondary Education Program

For those students interested in teaching, the College of Education offers a graduate degree program designed to prepare elementary and secondary teachers in mathematics. This provides the coursework and the experience required for certification in Massachusetts and in thirty-three other states. Interested persons may obtain additional information from the College of Education.

Mathematical Modeling in Industry and Government

For those students interested in graduate school or industry, the Department of Mathematical Sciences reaches out to

Department of Mathematical Sciences

industry and government to bring real world problems into the university. Three to five students work as a team for a full academic year to solve a single open problem contributed from a company or government agency. This team works closely with a faculty advisor and a liaison from the company or agency that is sponsoring the project to solve the problem during the Fall and Spring semesters. The Mathematical Modeling in Industry and Government program is designed to expose students to original research, large-scale problem solving and demands on mathematical research in society. Students who are interested should contact Prof. Rossi, OS 301B, (508) 934-4474.

Honors in Mathematics

Honors in the Major Field

Selected Mathematics students may qualify for honors in the major field. University requirements for major field honors are described elsewhere under the heading "Honors Program". Superior students are given the opportunity to pursue a more intensive program. The formal granting of honors provides recognition of outstanding interest and performance in mathematics. To earn departmental honors, a student must complete a minimum of 12 credits in honors or graduate mathematics courses in addition to the minimum university requirements.

Pi Mu Epsilon

Pi Mu Epsilon is a national honorary mathematics fraternity. Our chapter is Massachusetts Delta. Election to the fraternity is based on overall cumulative grade-point average and a separate cumulative grade-point average for mathematics courses only. Sophomores, juniors, seniors, and graduate students are eligible for election.

Mathematics Achievement Awards

These are given to the top graduating seniors with a major in Mathematics. Ordinarily two students are chosen to receive these awards.

Mathematics Minor

The Mathematical Sciences Department offers minors for students not majoring in Mathematics. A student who successfully completes the coursework gains depth in

mathematics beyond the requirements of the student's major department.

Completion of the minor allows the student to receive recognition for this accomplishment. In order to earn a minor the student must file with the registrar an academic petition approved by the Mathematical Sciences Department. This should be done immediately after registration for the courses that will complete the minor.

General Minor

A minor in Mathematics consists of 18-24 credits chosen from the mathematics major core and option lists. At least nine of these credits must be in mathematics courses which are not required by the student's major department. A minimum of six credits must be in courses on or above the 300 course level. Linear Algebra II may be substituted for one of the 300 level courses. Prof. Kaiser, OS 301, coordinates this program.

Computer Option Minor

The Computer minor consists of five courses and 15 semester hours as specified below.

Requirements:

1. Prerequisites: 92.132 Calculus II and one computer course as required by the student's major;
2. 92.267 C Programming or 91.101 Computing I
3. 92.321 Discrete Structures or 92.221 Linear Algebra I; and
4. Any three courses from an approved list in the Mathematical Sciences Department office.

This minor is not available to students majoring in Mathematics or Computer Science. Prof. Doerr, OS 221, coordinates this program.

Five year B.S. Program in Mathematics

The five year B. S. program is for students who need an extra year in order to take Precalculus and College Trigonometry. This is a 129-credit program. Contact the departmental office for details on this program.

Five year B.S./M.S. Program in Mathematics

General description: The five year B.S./M.S. program consists of 120 hours of undergraduate credit and 30-33 hours of graduate credit depending on the graduate option. The 120 hours of undergraduate credit must satisfy all the requirements for an undergraduate degree in mathematics, and the 30 hours of graduate credit must satisfy all the requirements for a Master of Science degree in the chosen option. The options are Applied Mathematics, Scientific Computing, Statistics and Operations Research, and Teacher.

One advantage of the program is that it makes it easier to finish both the B.S. degree and the M.S. in a total of five years. A second advantage is that spreading the 30 hours of graduate credit over a three-year period provides a wider selection of graduate courses. Not all graduate courses are offered on a yearly basis.

Eligibility: Any student who has completed three semesters of the undergraduate mathematics program with a grade point average, overall and in mathematics, of 3.000 or better is eligible for the program. Advanced placement students may apply earlier. An interested student should schedule an appointment with the program coordinator. Following this conference, a student who decides to apply for admission to the program must send a letter of application to the graduate coordinator in the Department of Mathematical Sciences. A committee of the graduate faculty will review the student's record and rule on the application.

With the approval of the Department Graduate Selection Committee the student will file a formal application to the Graduate School during the second semester of the junior year. The student need not have taken the Graduate Record Examination. The committee decision will be based on: a) overall grade point average, b) grade point average in selected subjects, c) recommendations by department faculty, and d) a one year minimum residency at UMass Lowell. Upon approval and recommendation by the Dean of the Graduate School the student may officially become a provisional graduate student in the second semester of the senior year.

Program Planning: The expectation is that the student will begin electing graduate

COLLEGE OF ARTS AND SCIENCES

Department of Mathematical Sciences

courses during the junior year. The Graduate School catalogue has a complete description of the requirements and options for the M.S. degree. Two approved 400-level courses (six credit hours) may be counted toward the 30 hours of graduate credit required, but these courses may not be included in those used for the undergraduate degree.

Degree Requirements

I. University General Education Requirements (18 credits)

Note: General Education requirements include eight elective courses in the areas of:

Aesthetics	3 cr
Behavioral and Social Sciences	6 cr
Historical Studies	3 cr
Literature	3 cr
Values, Concepts and Choice	3 cr
English Composition	6 cr

Specific courses that satisfy these requirements are updated periodically. Other General Education requirements in College Writing, Mathematics and Science are satisfied by required courses listed below.

II. Major Field Requirements

A. Mathematics 57 cr

1. Required Courses 45 cr

Calculus sequence
Calculus I, II, and III or
Calculus IA, IB, II, and III or
AP Credit, Honors Calculus II and III 12 cr

92.221	Linear Algebra I	3 cr
92.222	Linear Algebra II	3 cr
92.234	Differential Equations	3 cr
91.101	Computing I	3 cr
92.301	Intro to Applied Math I	3 cr
92.305	Intro to Real Analysis I	3 cr
92.307	Prob & Math Statistics I	3 cr
92.308	Prob & Math Statistics II	3 cr
92.321	Discrete Structures I	3 cr
92.411	Complex Variables I	3 cr
92.421	Abstract Algebra I	3 cr
92.450	Math Modeling Seminar or 92.457/458 Modeling in Ind. & Gov.	3 cr 6 cr

Note: Only four credits from Calculus IA/IB may be applied to a mathematics degree.

2. Option Requirements & Electives 12 cr

Option Requirements

a. Actuarial Mathematics

Three courses including at least one at the 400 level.

92.362	Numerical Analysis I
92.381	Operations Research I
92.382	Operations research II
92.409	Demography
92.416	Theory of Interest
92.417	Actuarial Mathematics
92.452	Statistical Theory
92.483	Applied Statistical Methods
92.591	Stat Modeling & Data Analysis
b. Applied Mathematics	
92.362	Numerical Analysis I

Plus one course chosen from the following list:

92.442	Boundary Value Problems
92.443	Theory of Ordinary Differential Equations
92.454	Numerical Analysis II
92.483	Applied Statistical Methods
92.584	Stochastic Processes
92.505	Discrete Mathematics
92.567	Numerical Methods for ODE's

Plus any 500-level courses approved for the applied mathematics option of the M.S. program, except 92.563 or 92.564.

c. Computer

92.360	Intro to Data Structures
92.455	Assembly Lang Programming I

Plus one course chosen from:

92.362	Numerical Analysis I
92.560	Data Structures
92.563	Numerical Analysis
92.564	Numerical Algebra
92.583	Cryptography
92.586	Coding Theory
92.591	Stat Modeling & Data Analysis

Plus any 500-level courses approved for the scientific computing option for the M.S. degree.

d. Statistics

92.452	Mathematical Statistics
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Plus two courses chosen from:

92.362	Numerical Analysis I
92.483	Applied Statistical Methods
92.584	Stochastic Processes
92.489	Topics in Statistics
92.505	Intro to Discrete Mathematics
92.582	Time Series Analysis
92.591	Stat Modeling & Data Analysis

92.592	Multivariate Statistical Model
92.593	Experimental Design

Plus any 500 level courses approved for the statistics option for the M.S. degree.

e. Teaching

Three courses chosen from:

92.410 or 92.510	Computers & Calculators in Classroom
92.413 or 92.513	Number Theory
92.420 or 92.520	Mathematical Problem Solving
92.427 or 92.527	Geometry
92.435 or 92.535	History of Mathematical Sciences

f. General (no option)

Three courses selected from the previous option lists including at least one course at the 400 level or above.

Certain courses which are offered infrequently may satisfy option requirements. A list of such courses will be available each semester in the departmental offices.

Elective: In addition to the above, one mathematics course which may be any mathematics course except: 100 level courses, 92.203, 92.207, 92.208, 92.209, 92.216, 92.271, 92.283, 92.302, 92.311, 92.317, 92.385, and 92.386.

B. Supporting Sciences 16 cr

Sixteen credits in approved laboratory science courses distributed to conform to the College requirement are required. At least one year of physics is strongly recommended.

Approved Sequences

Biological Sciences: 81.111, 81.112, 81.113, 81.114

Chemistry: 84.121, 84.122, 84.123, 84.124

Geology: 89.121 and 89.123 plus 89.316 and 89.318, or 89.251 and 89.253, or 89.208 and 89.210, or 89.203 and 89.205, or 89.232 and 89.234

Life Sciences: 83.101, 83.102, 83.103, 81.104

Physics: 95.141, 95.144, 96.141, 96.144; or 95.201, 95.202, 96.103, 96.104

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Radiological Sciences: 98.401, 98.402,
98.403

Other sequences may be approved, but no
more than eight credits in life science may
be applied to this requirement.

C. Technical Writing Requirement 3 cr

42.225 Tech and Sci Writing* or
42.306 Professional Writing

* normally offered only through
Continuing Education

D. Computing 3 cr

91.101 Computing I or equivalent

E. Minors and Electives 14-17 cr

1. A minor may be elected in another
department. Among the minors that are
available in the College of Arts &
Sciences: Biological Sciences,
Chemistry, Economics, Geology,
Physics, and Radiological Health
Physics.
2. The courses making up the electives
and/or minor:
 - a. must bear a course number pre-
fix other than 90 or 92;
 - b. may be from the same depart-
ments as courses satisfying the core
requirements;
 - c. must not overlap or duplicate
mathematics courses. Examples of
such courses are: 16.228, 16.315,
16.420; 64.211, 64.212, 66.204;
80.161, 80.162, 80.227, 80.398,
and 80.499.

Note: Courses making up a minor may not
be used to satisfy the University core
requirement.

III. Minimum 120 Credit Requirement

Sample Course of Study

For students entering in Fall 1993 and
subsequently

Freshman Year

Fall Semester

92.131 Calculus I* 4
91.101 Computing I 3

95.141 Physics I 4
96.141 Physics I Lab 1
42.101 College Writing I (Gen Ed) 3
15

Spring Semester

92.132 Calculus II 4
92.321 Discrete Structures I 3
95.144 Physics II 3
96.144 Physics II Lab 1
42.102 College Writing II (Gen Ed) 3
14

Sophomore Year

Fall Semester

92.231 Calculus III 4
92.221 Linear Algebra I 3
Supporting Science 3
Supporting Science Lab 1
42.225 Tech & Scientific Writing or
42.306 Professional Writing 3
General Education Req** 3
17

Spring Semester

92.234 Differential Equations 3
92.222 Linear Algebra II 3
Supporting Science 3
Supporting Science Lab 1
General Education Req.** 3
General Education Req** 3
16

Junior Year

Fall Semester

92.301 Applied Math I 3
92.307 Probability & Statistics I 3
92. Math Option (400 or above) 3
General Education Req** 3
Non-math Elective 3
15

Spring Semester

92.305 Real Analysis I 3
92.308 Probability & Statistics II 3
92. Math Option (300 or above) 3
General Education Req** 3
General Education Req** 3
15

Senior Year

Fall Semester

92.411 Complex Variables I 3
92.421 Abstract Algebra I 3
92. Math Option (400 or above) 3

General Education Req** 3
Non-math Elective 3

15

Spring Semester

92.450 Math Modeling Seminar 3
92 Math Elective 3
Non-math Elective 3
Non-math Elective 3
Non-math Elective 3

15

*Alternative sequence: Calc IA 92.127,
Calc IB 92.128, Calc II 92.132, Calc III
92.231; or Precalc 92.121, Calc I 92.131,
Calc II 92.132, Calc III 92.231.

**Note: General Education requirements
include eight elective courses in the areas
of Aesthetics (3 cr), Behavioral & Social
Studies (6 cr), Historical Studies (3 cr),
Literature (3 cr), and Values, Concepts &
Choice (3 cr). Specific courses that satisfy
these requirements are updated periodi-
cally. Other General Education require-
ments in College Writing, Mathematics &
Science are satisfied by courses listed
above.

**Mathematics Courses
(Prefix: 92)**

92.110 College Algebra

Reviews algebra with the goal of enhanc-
ing the student's understanding of basic
mathematics. Lays the groundwork for
further courses such as Mathematical
Perspectives and Introduction to Statistics.
I(2,2)3 This course does not satisfy the
university General Education requirement
in Mathematics.

92.111 Mathematical Perspectives

An introduction to the nature of mathe-
matics, providing insights into what mathe-
matics is, what it accomplishes, and how
it is pursued as a human enterprise.
Stresses concepts and relevance to modern
experience with topics drawn from areas
such as inductive and deductive reason-
ing, number systems, algebra, geometry,
probability, and statistics. Prerequisite:
Two years of high school algebra. No
credit toward a degree in science or engi-
neering. II(2,2)3

92.115 College Trigonometry

Angles and their measure, the trigonomet-
ric functions, solving triangles, law of

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sines, law of cosines, circular functions and their graphs, and trigonometric identities. No credit toward a degree in science or engineering. Prerequisite: 92.121 or equivalent. II(3,0)3

92.121 Management Precalculus

Review of algebra: operations on the real numbers, exponential notation, factoring, radical notation, and rational exponents. Linear and fractional equations, inequalities, radical equations, and quadratic equations. Relations, functions, graphs, symmetry, straight lines, circles, parabolas, systems of equations, and mathematical models. No credit toward a degree in science or engineering. I,II(2,2)3

92.122 Management Calculus

Differential calculus: limits, continuity, derivatives, differentials, higher-order derivatives, implicit differentiation, maxima and minima of functions, and applications of derivatives to business and economics. Integrals & Applications to business. Prerequisite: 92.121. Primarily for students in Management. No credit toward degree in science or engineering. II(2,2)3

92.124 Mathematics for Science and Engineering

Reviews some high-school mathematics for prospective calculus students. The following topics are included: fractions, exponents and radicals; relations, functions, and graphs; exponential and logarithmic functions; trigonometry and the trigonometric functions; imaginary and complex numbers; polynomials and rational functions; the conic sections. A graphics calculator is required for this course. No credit toward a degree in science or engineering. II(3,0)3

92.127 Calculus IA

A review of precalculus algebra and trigonometry integrated with the first half of Calculus I. Functions, limits, continuity, the derivative, the chain rule, related rate problems. For technical degree programs, including Mathematics, only two credits of this course may be applied toward a degree. I,II(4,0)4

92.128 Calculus IB

A review of precalculus algebra and trigonometry integrated with the second half of Calculus I. Implicit differentiation, max/min problems, and curve sketching. Integrals and areas. For technical degree

programs, including Mathematics, only two credits of this course may be applied toward a degree. For prerequisites, completion of this course is equivalent to 92.131. Prerequisite: 92.127. I,II(4,0)4

92.131 Calculus I

A first calculus course. Functions, limits, continuity, derivatives, rules for differentiating algebraic and transcendental function; chain rule, implicit differentiation, related rate problems, max/min problems, curve sketching; integrals and areas. I,II(4,0)4

92.132 Calculus II

A continuation of Calculus I. Volume, arc length, surface area, pressure and force. Differentiation and integration of trigonometric, inverse trigonometric, exponential, logarithmic, and hyperbolic functions. Improper integration, infinite series, Taylor and MacLauren series. Prerequisite: 92.131. I,II(4,0)4

92.142 Honors Calculus II

This course is offered to students in the Honors Program who have been granted AP credit prior to entering the university. It includes all topics covered in 92.132 Calculus II. I(4,0)4

92.183 Intro to Statistics

Sets and probability laws, random variables, mathematical expectations, measure of central tendency and variance. Study of discrete and continuous probability distribution, sampling theory, tests of hypothesis. Regression and correlation. May not be taken for credit along with 92.283, 92.385 or 92.386. May not be used to satisfy Mathematics major requirements. I,II(3,0)3

92.203 Mathematics of Music

Review of algebra and logarithms: application to the construction of musical scales (Pythagorean, tempered, mean-tone and just); loudness levels and decibels; review of trigonometry; application to the analysis and synthesis of musical sound from harmonics; elementary signal processing; hearing and the ear. Harmonic synthesis is demonstrated on a digital synthesizer coupled to an oscilloscope. Prerequisite: 92.115. I,II(3,0)3

92.207 Mathematical Techniques of Physics I

Hyperbolic functions, polar coordinates, vectors and parametric equations, solid geometry and vectors, partial differentiation, multiple integrals. Physics majors only. Prerequisite: 92.132. I(4,0)4

92.208 Mathematical Techniques of Physics II

Infinite series, differential equations: first order, linear, and power series solutions. Vector differential calculus, vector fields. The integral theorems of Green, Gauss, and Stokes. Physics majors only. Prerequisite: 92.207. II(4,0)4

92.211 Introduction to Programming I with C

Offers an introduction to the processing of information by computer. Topics: computer logic, memory, input/output processing, loops, decisions, and program design in the "C" language. 3 cr. Prerequisite 92.121 or equivalent.

92.212 Introduction to Programming II with C

Serves as a continuation of 92.211. Additional topics: pointers, dynamic memory allocation, file handling techniques and libraries. 3 cr. Prerequisite 92.211.

92.216 History of Mathematics

An investigation of creative mathematics through the lives of mathematicians from classical times to the present. I(3,0)3

92.221 Linear Algebra I

Elementary set theory and solution sets of systems of linear equations. An introduction to proofs and the axiomatic methods through a study of the vector space axioms. Linear analytic geometry. Linear dependence and independence, subspaces, basis. Inner products. Matrix algebra. I(3,0)3

92.222 Linear Algebra II

Linear transformations. Linear operators, change of basis, and the diagonalization problem. Quadratic forms. Convex sets and geometric programming, input/output models for an economy, Markov chains, other applications of linear algebra. Prerequisites: 92.221 and 92.132. II(3,0)3

92.231 Calculus III

A continuation of Calculus II. Polar Coordinates, parametric equations, vectors and analytic geometry in space. Functions of several variables, partial derivatives, and chain rule. Tangent planes and normal lines. Maxima and minima, Lagrange multipliers, and multiple integrals. Prerequisite: 92.132. I,II(4,0)4

92.234 Differential Equations

Classification and solution of ordinary differential equations of the first order and higher orders. The Laplace transform. Applications. Prerequisite: 92.132. I,II(3,0)3

92.241 Honors Calculus III

This course is offered to students in the Honors Program who have been granted AP credit prior to entering the university. It includes all topics covered in 92.132 Calculus III. For prerequisites, completion of this course is equivalent to 92.231. Prerequisite: 92.142 II(4,0)4

92.265 Pascal Programming

An introduction to computer programming using Pascal. Topics covered include: algorithmic development by step-wise refinement, control structures, functions and procedures, the standard data types, scalar data types, and an introduction to structured types. I,II(3,0)3

92.267 C Programming

Introduces students to the techniques of programming in C. The language syntax, semantics, its applications and the portable library are covered. Prerequisite: 92.265 (3,0)3

92.271 Differential Equations for Chemical Equations

Ordinary differential equations with intensive coverage of Laplace Transforms, including step and control functions. Series solutions, including methods of Taylor, Frobenius, and Bessel. Methods of solution of partial differential equations and boundary value problems. Vector calculus. Numerical analysis including Newton's and Runge-Kutta Methods, error analysis, and finding polynomials from difference tables. May not be taken for credit with 92.234. Prerequisite: 92.231 or equivalent. Not open to Mathematics majors. I,II(4,0)4

92.283 Statistics for the Behavioral Sciences

An introduction to basic statistics as used in the behavioral sciences including descriptive statistics, sampling, the normal distribution, correlation and regression, and inferential statistics, including t-tests, F-tests, Chi-square tests and analysis of variance. The course also includes computer methods for solution of problems. May not be taken for credit along with 92.183 or 92.386. Prerequisite: 92.111 or equivalent. I,II(3,0)3

92.301 Intro to Applied Mathematics I

Vector analysis, Green's Theorem, Divergence Theorem, Stokes' Theorem. Fourier series and integrals. Partial differential equations of physics and engineering. Prerequisite: 92.231 and 92.234. I(3,0)3

92.302 Intro to Applied Mathematics II

Matrix algebra, solution of systems of linear equations, eigenvalues and eigenvectors, solution of differential equations by matrix methods. Series solution of differential equations. Bessel and Legendre functions. Sturm-Liouville problems. Prerequisites: 92.231 and 92.234. II(3,0)3

92.305 Intro to Real Analysis I

Real and complex number systems. Sequences and series of complex numbers. Theory of metric spaces: completeness, compactness, continuity, uniform continuity. Differentiability of functions. Taylor's theorem. Prerequisites: 92.221 and 92.231. II(3,0)3

92.306 Intro to Real Analysis II

Sequences and series of functions. Uniform convergence. Elementary functions. Functions between Euclidean spaces: the derivative as a linear map, the Jacobian, inverse function theorem, implicit function theorem, Taylor's theorem. Integration of real valued functions on Euclidean space, fundamental theorem of the integral calculus, change of variables formula. Prerequisite: 92.305. (3,0)3

92.307 Probability and Mathematical Statistics I

Probability, random variables, discrete and continuous densities, expectation and variance, special distributions (binomial, Poisson, normal, gamma, etc.), moment generating functions, joint and conditional distributions, transformations of variables, sampling, central limit theorem. Prerequisite: 92.231. I(3,0)3

92.308 Probability and Mathematical Statistics II

Point estimation and confidence intervals, hypothesis testing, correlation, linear regression, analysis of variance for the one- and two-way design, nonparametric methods, chi-square tests for contingency tables. Prerequisite: 92.307. II(3,0)3

92.321 Discrete Structures I

Propositional logic, combinatorics, proof methods, mathematical systems; algebraic sets, matrix algebra, relations, functions; recursion and generating functions. Applications to Computer Science. I(3,0)3

92.322 Discrete Structures II

Graph theory, trees, algebraic systems. Boolean algebra, groups, monoids, automata, finite-state machines, rings, fields. Applications to coding theory, sorting, logic design. Prerequisite: 92.321. II(3,0)3

92.360 Intro to Data Structures

Basic concepts of data. Linear lists, strings, arrays, and orthogonal lists. Trees and graphs. Storage systems and structures. Storage allocation and collection. Multilinked structures. Symbol tables, searching and sorting (ordering) techniques. Prerequisites: 92.221 or 321 and 92.265 or 92.267. II(3,0)3

92.362 Numerical Analysis I

Theory and application of numerical techniques including error analysis. Solution of linear, nonlinear, and differential equations. Interpolation, numerical integration, and curve fitting. Computer solutions are emphasized. Prerequisite: 92.231/136, 92.234 and knowledge of one computer language. I,II(3,0)3

92.363 Intro to Data Analysis

Computer analysis of data derived from research conducted in physical, social, and life sciences. Data preparation. Data modification, file manipulation, and descriptive statistics using SPSS. Programming ability is not required. Prerequisite: 92.183 or equivalent. Also senior or junior status or permission of Chairperson. I,II(3,0)3

92.364 Problem Solving with Pascal

A practical problem solving course to provide the tools needed for software development. Problem specification and organization, algorithms, coding, debugging, the elements of good programming style. Both numeric and non-numeric applications. Prerequisite: 92.265. I,II(3,0)3

92.365 COBOL Programming I

Programming principles of COBOL (the Common Business Oriented Language), identification, environment, data, and procedures divisions, introduction to compilation procedures. I,II(3,0)3

92.368 COBOL Programming II

A continuation of 92.365, this hands-on course requires the student to generate a number of COBOL programs, utilizing the advanced components of the COBOL language. Topics begin with multidimensional tables and include a complete examination of COBOL input/output procedures with random and sequential files, the implementation of the SORT/MERGE and REPORT WRITER modules, and the use of the intercommunication facility for the support of subroutines written in COBOL, FORTRAN and assembly language. Prerequisite: 92.365. I,II(3,0)3

92.381 Intro to Operations Research Techniques I

The use of decision models in industrial systems. Fundamentals of probability and matrix theory. Critical path methods. Linear programming. The simplex method. Sensitivity analysis. Goal programming. Transportation and assignment models. Integer programming. Prerequisite: 92.131/135 or 92.201. I(3,0)3

92.382 Intro to Operations Research Techniques II

A continuation of 92.381. Topics include: inventory control models, Markov analysis, queuing models, dynamic programming, network analysis, and simulation techniques. Prerequisite: 92.381. II(3,0)3

92.385 Biostatistics

Probability distributions, measure of central tendency and variance, principles of statistical inference, analysis of variance employing nested and block designs, factorial experiments, multi-range comparison tests, analysis of covariance, correlation and regression, nonparametric statistics. The course includes computer methods for solutions of problems. May not be taken for credit along with 92.183 or 92.386. (For Biological Science majors only.) II(3,0)3

92.386 Statistics for Engineering and Science

A one semester course in probability and statistics with applications in the engineer-

ing sciences. Probability of events, discrete and continuous random variables, density functions, distributions. Estimation, hypothesis testing, regression and correlation. May not be taken for credit along with 92.183, 92.283 or 92.385. May not be used to satisfy Mathematics major requirements. Prerequisite: 92.132. II(3,0)3

92.403 Signal Analysis I

Signal processing systems, signal representations in the time and frequency domains, digital processing of analog signals, uncertainty and sampling, fast Fourier transform. Prerequisite: 92.306. I(3,0)3

92.404 Signal Analysis II

Band-limited functions, windows and extrapolation, Hilbert Transforms, frequency modulation, the uncertainty principle, ambiguity functions, random signals, correlations and spectra. Prerequisites: 92.403 and 92.411. II(3,0)3

92.409 Demography

The study, the methods, and the materials used in the systematic compilation and analysis of population data. Primary focus is on learning sources of data, definitions, collection techniques, population characteristics and dynamics, summarizing and analyzing data, and methods of estimating and projecting local populations. Prerequisite: 92.183 or equivalent. I(3,0)3

92.410 Computers and Calculators in the Classroom

This course explores the roles of mainframes, PC's and hand calculators in instruction, examine some of the available software and consider their use in a variety of areas of secondary mathematics, such as algebra, geometry (Euclidean and analytic), probability and statistics and introductory calculus. (3,0)3

92.411 Complex Variables I

Complex numbers. Functions of a complex variable, mappings, derivatives, analytic functions. Elementary functions. Laurent series, residues and poles, contour integration. Prerequisites: 92.231. I(3,0)3

92.412 Complex Variables II

Transformations. Conformal mappings. Boundary conditions. Applications in heat conduction, electrostatic potential, and fluid flow. Gamma and beta functions. Inverse Laplace transform. Riemann surfaces. Prerequisite: 92.411.

92.413 Number Theory

Congruences and Chinese Remainder Theorem, Primitive roots, quadratic reciprocity, approximation properties of continued fractions, Pell's equation. Recent applications of number theory such as primarily testing, cryptology, and random number generation. Prerequisite: 92.221 or 92.321. I(3,0)3

92.416 Compound Interest and Annuities-Certain

Basic concepts and definitions of various types of annuities, valuation of annuities-certain, valuation of securities and sinking funds, determination of yields, and construction of tables. Prerequisite: 92.231. I(3,0)3

92.418 Mathematical Methods of Engineering Economics

Analytical presentation of microeconomic theory as a unified body of knowledge. Mathematical treatment throughout. Linear programming, game theory, probabilistic models, input/output analysis, and Bayesian statistics used in problem solution. Prerequisite: 92.231. II(3,0)3

92.419 Computer Algebra with Mathematica

A project-based course starting with an introduction to the basic features of Mathematica. A project that allows the student to focus on certain features in more detail is required and occupies the second half of the course. (3,0)3.

92.420 Mathematical Problem Solving

Focuses on: mathematical resources, ability to use heuristics, the student's beliefs about the use of mathematics to solve problems, and the student's self confidence as a problem solver. Effective strategies for incorporating problem solving in the curriculum is also discussed. Prerequisite: 92.221 or 92.321. I(3,0)3

92.421 Abstract Algebra I

Elementary group theory, groups, cosets, normal subgroups, quotient groups, isomorphisms, homomorphisms, applications. Prerequisite: 92.221 or 92.321. I(3,0)3

92.422 Abstract Algebra II

Elementary ring and field theory, quotient rings and ideals, homomorphisms of rings, rings of polynomials, algebraic extensions, automorphisms of field, separable extensions. Galois Theory. Prerequisite: 92.421. II(3,0)3

92.427 Geometry

A wide survey of topics related to secondary school geometry; axiomatic systems and Euclidean geometry; constructions in geometry; geometry of vision, perspective and projective geometry; analytic geometry; and historical development. Prerequisite: 92.221 or 92.321. I(3,0)3

92.428 Computational Geometry

Processing of geometric data to identify properties and structures. Fundamental geometric pre-convex hull, Voronoi diagrams. I(3,0)3

92.431 Topology

Provides an introduction to the important concepts of point-set topology and a brief taste of algebraic topology. Included among the topics covered are: metric spaces and topological spaces; continuity, connectedness, and compactness; and the fundamental group. Prerequisite: 92.306. I(3,0)3

92.435 History of Mathematical Science

An ancient numeral systems, Babylonian and Egyptian mathematics, Pythagorean mathematics, duplication, trisection, and quadrature, Euclid's Elements and Greek mathematics after Euclid. Hindu and Arabian mathematics, European mathematics from 500 to 1600. Origins of modern mathematics, analytic geometry, history of calculus. Transition to the twentieth century, contemporary perspectives. Prerequisite: 92.231. I(3,0)3

92.442 Boundary Value Problems

Partial differential equations of physics and engineering. Boundary value problems, Fourier series, convergence tests. Sturm-Liouville problems. Orthogonal systems and generalized Fourier series. Fourier integrals and applications. Prerequisite: 92.306 or permission of instructor. I(3,0)3

92.443 Theory of Ordinary Differential Equations

Differential equations in Euclidean space. Existence, uniqueness, and continuation of solutions. Autonomous systems and the Poincaré-Bendixson theory. Linear and perturbed linear systems. Plane systems, the neighborhood of critical points and closed orbits. Liapunov stability. Periodic systems and Floquet theory. Prerequisite: 92.305. I(3,0)3

92.447 Vector Calculus for Science and Engineering

Cylindrical and spherical coordinate systems; curves and surfaces; differential forms; the exterior derivative as a generalization of the gradient, curl, and divergence; Stokes' Theorem and its various forms; a simple formulation of Maxwell's equations in terms of differential forms. Prerequisites: 92.222 and 92.231. II(3,0)3

92.450 Mathematical Modeling Seminar

Devoted to studying the application of mathematics in government and industry. It includes numerous case studies which employ the techniques of graphical, optimization, and dynamic modeling. Prerequisite: senior Math major or permission of instructor. II(3,0)3

92.452 Intermediate Mathematical Statistics

A survey of topics in mathematical statistics including those covered in the second actuarial exam. Maximum likelihood estimation, sufficient statistics, completeness and uniqueness, likelihood ratio tests, UMP tests, Rao-Blackwell theorem, non-central chi-squared and F distribution, SPRT, some multivariate distributions. Prerequisite: 92.307. II(3,0)3

92.454 Numerical Analysis II

Continuation of 92.362 including: numerical solution of ordinary and partial differential equations, boundary value problems, curve-fitting, error analysis, and computer solutions. Prerequisite: 92.362 and 92.234. II(3,0)3

92.455 Assembly Language Programming I

Absolute machine language coding and the symbolic programming language; the basic computer instructions including arithmetic, input/output, logic control operations, and data manipulation. The coding of practice problems on a high-speed digital computer. Prerequisite: 92.265 or permission of instructor. I,II(3,0)3

92.456 Assembly Language Programming II

A continuation of Assembly Language Programming I. Symbolic programming using advanced techniques including macro instructions, indirect addressing, file generation and processing, magnetic tape and magnetic disk applications.

Primarily offered during evening hours. Prerequisite: 92.455. II(3,0)3

92.457/458 Modeling in Industry and Government I,II

For those students interested in graduate school or industry. Three to five students work as a team for a full academic year to solve a single open problem contributed from a company or government agency. Designed to expose students to original research, large-scale problem solving and demands on mathematical research in society.

92.459 Artificial Intelligence

State-space representations, state-space search algorithms, problem-reduction representations, and problem-reduction search methods. The student is required to code and execute a number of programs in LISP. Primarily offered during evening hours. Prerequisite: 92.263 or 92.265, and permission of instructor. I(3,0)3

92.461 Systems Simulation and Modeling

Procedures in model construction and computerized simulation, modeling tools and techniques, model conceptualization and implementation, selected applications of simulation. Primarily offered during evening hours. Prerequisite: 92.263 or 92.265 or equivalent. I(3,0)3

92.462 Systems Programming

Basic concepts of assembly programs, compilers, macro-generators, utility programs, supervisors, monitors and high-level languages. Primarily offered during evening hours. Prerequisites: 92.360 and 92.455. II(3,0)3

92.465 Formal Languages

Principles of finite automata. Properties of languages accepted by finite automata. Context-free grammars and push-down automata. Turing machines and computability. Prerequisite: 92.265. Primarily offered during evening hours. I(3,0)3

92.466 Theory of Computation

Computability, undecidability, complexity. Turing machines and the halting problem. Elementary recursion theory. The Church-Turing thesis. Measures of complexity, the speed-up theorem. Proving theorems about programs. Primarily offered during evening hours. Prerequisite: 92.265. II(3,0)3

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92.469 Compiler Construction Techniques

Typical compiler organization is studied including symbol tables, various types of scans, object code generation, error diagnostics, and optimization techniques. Segments of a classroom compiler are written by students. Primarily offered during evening hours. Prerequisites: 92.360 and 92.455. I(3,0)3

92.470 Data Communications

Analysis and use of remote computing systems including time-sharing, remote-batch, and real-time systems. Design characteristics, applications, data communications, economics and management of such systems. Primarily offered during evening hours. Prerequisites: 92.265 and 92.360. II(3,0)3

92.471 Intro to the Design and Analysis of Algorithms

Basic steps in developing an algorithm, correctness, algorithm design techniques such as hill climbing, subgoals, heuristics, backtracking, branch and bound, recursion, sorting and searching, paging, parallelism, algorithm and program correctness; measures of algorithm efficiency, complexity, and overall effectiveness. Primarily offered during evening hours. Prerequisite: permission of instructor. I(3,0)3

92.474 Database Concepts

An introduction to database directives, design element of three databases, architectures, and commercial databases is presented. Students participate in design of a large scale database application. Administration of the database. Students program the basic concepts on a machine. Primarily offered during evening hours. Prerequisites: Two semesters of high-level language, excluding BASIC. II(3,0)3

92.477 Management Info Systems I

Analysis and evaluation of third generation integrated software systems including hardware for requirements, routine and demand reports, architectural evaluation for integrated business function control and the data base design. Primarily offered during evening hours. I(3,0)3

92.478 Management Info Systems II

Automated decision-making models, systems user consideration, the economics of MIS including effects on management organization, personnel, and data manage-

ment. Primarily offered during evening hours. Prerequisite: 92.477. II(3,0)3

92.481 Operations Research I

General linear programming problem, simplex method, duality and sensitivity analysis, transportation and network problems, dynamic programming, integer (linear) programming, PERT. Prerequisite: 92.221. I(3,0)3

92.482 Operations Research II

Probability review (moment generating functions and Z-transforms). Inventory models, queuing theory, Markov chains, and decision models. Nonlinear programming. Prerequisite: 92.481. II(3,0)3

92.483 Applied Statistical Methods

The development of statistical techniques without the use of calculus. Analysis of variance, multiple and curvilinear regression, and nonparametric methods. Prerequisite: 92.386 or equivalent. I(3,0)3

92.489 Topics in Statistics

Topics from the literature of statistics. May be repeated an indefinite number of times, but particular topics must differ. Prerequisite: permission of instructor. I(3,0)3

Directed Studies

Directed studies courses are available only to Mathematics majors and may be elected provided that 1) material to be covered is not available in any other mathematics course, 2) instructors are willing to undertake a directed studies, and 3) no more than nine credits in mathematics are taken in directed studies courses.

92.490 Directed Studies in Computer Mathematics

Individual study for the student desiring more advanced or more specialized work relating to the computer. May be repeated for a total of six semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of Department Chairperson. I,II(3,0)3

92.491 Directed Studies in Analysis

Individual study for the student desiring more advanced or more specialized work in analysis. May be repeated for a total of six semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of Department Chairperson. I,II(3,0)3

92.492 Directed Studies in Algebra

Individual study for the student desiring more advanced or more specialized work in algebra. May be repeated for a total of six semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of Department Chairperson. I,II(3,0)3

92.493 Directed Studies in Geometry

Individual study for the student desiring more advanced or more specialized work in geometry. May be repeated for a total of six semester credits. Course may not be substituted for scheduled offerings. Prerequisite: permission of Department Chairperson. I,II(3,0)3

500 level courses are primarily for graduate students, but all graduate courses are open to qualified undergraduate students with permission of the instructor.

92.500 Discrete Structures

An introduction to discrete mathematics, including combinatorics and graph theory. The necessary background tools in set theory, logic, recursion, relations, and functions are also included. Masters degree credit for Teacher Option Only. (3,0)3

92.501 Real Analysis I

Real and complex number systems; sequences and series; topology of the real line: completeness, compactness, continuity; differentiability of single variable functions; and sequences and series including uniform convergence. (3,0)3

92.502 Real Analysis II

Topology of metric spaces, multivariable functions, derivative as linear maps, Jacobians, inverse and implicit function theorem, Taylor's theorem, and introduction to measure theory. (3,0)3

92.503 Mathematical Analysis

Metric spaces: completeness, compactness, connectedness; and continuity, discontinuities, uniform convergence, power series, differentiation, and integration. Masters degree credit for Teacher Option Only. (3,0)3

92.505 Discrete Mathematics

Basic counting rules, permutations and combinations, recurrence relations. Asymptotic algorithms analysis, NP-completeness, heuristic algorithms. Linear, integer, and dynamic programming. Coding Theory Applications. Prerequisite: Linear Algebra or Discrete Structures. (3,0)3

92.507/508 Applied Functional Analysis I, II

Vector, metric, normed, Banach and Hilbert spaces. Spectral theory of linear, compact, and unbounded linear operators. Integral and differential equations, approximation theory, and quantum mechanics. I(3,0)3, II(3,0)3

92.510 Computers and Calculators in the Classroom

Explores the roles of mainframes, PCs and hand calculators in instruction, examine some of the available software, and consider their use in a variety of areas of secondary mathematics, such as algebra, geometry (Euclidean and analytic) probability and statistics, and introductory calculus. Masters degree credit for Teacher Option Only. (3,0)3

92.511 Complex Variables I

Complex numbers, elementary functions and their geometric representation. Differentiation and integration. Power series. Singularities. Entire and meromorphic functions. Periodic functions. (3,0)3

92.512 Complex Variables II

Differentiation and integration of complex analytic functions. Cauchy's integral theorem and formula. Singularities and Laurent series. Theory of residues and applications. Harmonic functions. Conformal mapping. Prerequisite: 92.501. (3,0)3

92.513 Number Theory

Study of primes, congruences, number-theoretic functions, Diophantine approximation, quadratic forms and quadratic number fields. Additional topics as time permits. (3,0)3

92.516 Pattern Recognition

Random vectors: transformations of random vectors. Hypothesis Testing: error probability; sequential tests; supervised learning; Nearest Neighbor and Parzen Kernel Approach and feature extraction. Prerequisites: calculus, probability, matrix algebra. (3,0)3

92.520 Mathematical Problem Solving

Mathematical resources; heuristics; control of resources and heuristics; and belief systems. Strategies for incorporating problem solving into the curriculum. Masters degree credit for Teachers Option Only. (3,0)3

92.521 Algebraic Structures I

Properties of rings, groups, fields, polynomials over fields, extension rings and fields, vector spaces, codes, and additional applications. (3,0)3

92.523 Linear Algebra I

Sets and maps; vector spaces and linear maps, matrix of linear maps, solving systems of equations, scalar products and orthogonality, eigenvalues and applications. Masters degree credit for Teachers Option Only. (3,0)3

92.527 Geometry

A wide survey of topics related to secondary school geometry: axiomatic systems and Euclidean geometry; constructions in geometry; geometry of vision, perspective and projective geometry; analytic geometry; historical development. Masters degree credit for Teachers Option Only. (3,0)3

92.529 Differential Geometry

Differential geometry involving curves and surfaces in 3-space. Curvature, torsion, Frenet equations, intrinsic equations, involutes and evolutes. (3,0)3

92.530 Applied Mathematics I

Matrices, vector analysis, divergence, Green's and Stokes' theorem, series solution of differential equations, boundary value problems. Fourier series and integrals. Partial differential equations, separation of variables. I(3,0)3

92.531 Applied Mathematics II

A continuation of 92.530. II(3,0)3

92.535 History of Mathematical Science

Ancient numeral systems, Babylonian and Egyptian Mathematics, Pythagorean mathematics, duplication, trisection and quadrature, Euclid's Elements and Greek mathematics after Euclid, Hindu and Arabian mathematics, European mathematics from 500 to 1600, origins of modern mathematics, analytic geometry, history of calculus, transition to the 20th Century, contemporary perspectives. Masters degree credit for Teachers Option Only. (3,0)3

92.537 Vector & Tensor Analysis I

The geometry of curves and surfaces, Serre-Frenet formulas, intrinsic equations of a curve, first and second fundamental forms of a surface, divergence, curl, and gradient. (3,0)3

92.538 Vector & Tensor Analysis II

Tensor algebra, covariant and contravariant differentiation and parallel displacement. Applications to differential geometry and selected topics. (3,0)3

92.539 Differential Forms & Their Applications I

Vector calculus; curves and surfaces; differential forms and multilinear maps. (3,0)3

92.540 Differential Forms & Their Applications II

The gradient, curl, and divergence as exterior derivatives; the general Stokes' Theorem; applications to electrodynamics and thermodynamics. (3,0)3

92.541,542 Fourier Analysis & Boundary Value Problems I,II

Fourier series and integrals. Orthogonal systems and Sturm-Liouville problems. Applications to boundary value problems in rectangular, cylindrical, and spherical coordinates. Distributions and their applications. Prerequisite: 92.501 (3,0)3

92.543 Ordinary Differential Equations

Existence, uniqueness, and smoothness of solutions. The Poincaré-Bendixson theory. The neighborhoods of critical points and closed orbits. Liapunov stability. Linear and perturbed linear systems. Prerequisite: 92.501. (3,0)3

92.545 Partial Differential Equations I

Introduction to partial differential equations in the plane and space with engineering applications. Solution of initial and boundary value problems. Complex variables and transform theory. (3,0)3

92.546 Partial Differential Equations II

A continuation of 92.545. (3,0)3

92.547 Integral Equations

Exact, iterative, and numerical techniques for the solution of linear Volterra and Fredholm integral equations, theorems for general operators. Symmetric kernels, orthogonal system of functions, and the Hilbert-Schmidt theorem. Applications. (3,0)3

92.548 Math of Signal Processing I

Representation of signals: Fourier analysis, fast Fourier transforms, orthogonal expansions. Transformation of signals: linear fil-

ters, modulation; band-limited signals; sampling; uncertainty principle; Windows and extrapolation. Prerequisite: 92.501. (3,0)3

92.550 Mathematical Modeling

Devoted to studying the application of mathematics to real-life problems from the physical, biological, social, and behavioral sciences. Provides experience in a wide variety of models (deterministic, stochastic, simulation, continuous, discrete, axiomatic). Encourages computer use in problem solving. Prerequisite: 92.234. Masters degree credit for Teacher Option Only. (3,0)3

92.551 Calculus of Variations

The first variational problem, necessary conditions. Euler's equation. Generalization to dependent and independent variables. Constraints and Lagrange multipliers. Application to dynamics and elasticity. Direct methods. Prerequisite: 92.501. (3,0)3

92.552 Wavelet Analysis

Introduction to time-frequency localization of signals; frames; windowed Fourier transforms; continuous and discrete wavelet transforms; time frequency sampling theorems; orthonormal bases of wavelets; algebraic wavelet theory; applications to electrodynamics and optics. Prerequisite: A working knowledge of Fourier series and integrals and some familiarity with orthogonal expansions of functions. Consult the instructor. II(3,0)3

92.560 Data Structures & Algorithms I

Implementations of lists, stacks, queues, ordered and binary trees, and priority queues. Tree traversals. Open and closed hashing. Directed graphs: shortest paths and acyclicity. Prerequisite: Discrete Structures and Introduction to Data Structures. (3,0)3

92.563 Numerical Analysis

Nonlinear equations in one and several variables. Numerical differentiation and integration. Numerical methods for ordinary differential equations and for the Laplace, heat, and wave equations. Prerequisite: 92.501. (3,0)3

92.564 Numerical Algebra

Solution of linear systems. Eigenvalue, eigenvector problem. Fast Fourier Transform. Introduction to finite elements. Least squares. Splines, Chebyshev approximation. (3,0)3

92.565 Formal Languages

Principles of finite automata. Properties of languages accepted by finite automata. Context-free grammars and push-down automata. Turing machines and computability. Prerequisite: Pascal. (3,0)3

92.566 Theory of Computation

Computability, undecidability, complexity. Turing machines and the halting problem. Elementary recursion theory. The Church-Turing thesis. Measures of complexity, the speed-up theorem. Proving theorems about programs. Prerequisite: PASCAL computability, undecidability, complexity. (3,0)3

92.570 Probability and Statistics

Overview of descriptive statistics, data analysis, probability of events, discrete random variables, continuous random variables, normal, binomial and other probability distributions, central limit theorem, survey sampling, estimation, hypothesis testing, regression, experimental design, analysis of categorical data, nonparametric statistics. Masters degree credit for Teachers Option Only. (3,0)3

92.571 Linear Optimization

Simplex and revised simplex methods, duality, sensitivity analysis, the transportation problem and other applications, degeneracy procedures, computational techniques. Introduction to integer programming. (3,0)3

92.572 Nonlinear Optimization

Unconstrained optimization, Lagrange multipliers, Kuhn-Tucker theory, quadratic programming, convex programming, numerical methods. (3,0)3

92.575 Data Structures & Algorithms II

Divide and conquer, radix and comparison sorts, order statistics, union-find, balanced trees, graph connectivity, path finding, matrix multiplication, Fast Fourier transform, pattern matching, NP-completeness. Prerequisite: 92.560. (3,0)3

92.579 Reliability Life Data Analysis

Introduces statistical methods for analyzing data obtained from lifetime testing of products. Statistical failure models, testing reliability hypotheses and accelerated life testing. Prerequisites: Probability or Statistics for Engineering and Science. (3,0)3

92.580 Combinatorics

Generating functions, recurrence relations, inclusion-exclusion, Polya theory. Experimental designs (block design). Partially ordered sets. Applications. Prerequisites: Calculus and Discrete Structures. (3,0)3

92.581 Graph Theory

Terminology, theorems, algorithms, and applications of graph theory. Trees, circuits, and connectivity. Hamiltonian and Eulerian graphs. Shortest routes, matching, network flows. Covering, coloring, Ramsey theory. Prerequisite: Linear Algebra or Discrete Structures. (3,0)3

92.582 Time Series Analysis

Building models for discrete time series and dynamic systems and their use in forecasting and control. Stationary and non-stationary time series models. Box-Jenkins (ARMA) and other techniques. Prerequisite: permission of the instructor. (3,0)3

92.583 Cryptography

Basic concepts; some classical cryptographic examples; modern encryption algorithms, the Data Encryption Standard (DES), public key systems probabilistic encryption; aspects of key management and inference controls in statistical data bases. Prerequisite: permission of instructor. (3,0)3

92.584 Stochastic Processes

Markov chains and processes, random walks, stationary, independent increments, and Poisson processes. Ergodicity. Examples (e.g. diffusion, queueing theory, etc.). Prerequisite: Probability or Mathematical Statistics I. (3,0)3

92.585 Queueing Theory

Single-server queueing systems, queue length, and waiting time. Multi-server queueing systems. Modeling of telephone systems, interactive computer systems. Prerequisites: Statistics and Probability. (3,0)3

92.586 Coding Theory

Error correcting and decoding. Applications to data processing, transmission and security. Linear block, cyclic, convolution and arithmetic codes. Applications from communications and computer science. Prerequisite: Discrete Structures. (3,0)3

92.587 Probability and Mathematical Statistics

Algebra of probabilities, random variables, classic distributions. Measure-theoretic axiomatic. Analytical methods. Limit theorems. Statistical methods: sampling, estimation, regression and correlation. Prerequisite: 92.501. (3,0)3

92.588 Mathematical Statistics

Random variables, densities, joint and conditional distributions, expectations, variance, estimation, sufficiency and completeness, hypothesis testing, limiting distributions. (3,0)3, (3,0)3

92.589 Theory and Methods of Sampling from Finite Populations

Simple random sampling, systematic sampling, stratified random sampling, multi-stage cluster sampling, regression estimation, ratio estimation, effect of costs on sample allocation and nonsampling errors. (3,0)3

92.590 Statistical Quality Control

Introduction to statistical methods useful in quality assurance. Description of control charts for attributes and variables, process-capability analysis and acceptance sampling. Prerequisite: Probability or Statistics for Engineering & Science. (3,0)3

92.591 Regression Analysis

Model building via linear regression models. Method of least squares, theory and practice. Checking for adequacy of a model, examination of residuals, checking outliers. Practical hands-on experience in linear model building on real data sets. Prerequisite: Probability, Biostatistics, or Statistics for Engineering and Science. (3,0)3

92.592 Multivariate Statistical Modeling

Nonlinear model building via the method of least squares. Discriminant and factor analysis, principal components, profile analysis, canonical correlation, cluster analysis. Experience on real data sets. (3,0)3

92.593 Experimental Design

How to design, carry out, and analyze experiments. Randomized block designs, randomization, blocking, matching, analysis of variance and covariance, control of extraneous variables. (3,0)3

92.594 Control Theory

Analytical and numerical methods for optimization of deterministic and stochastic dynamic systems. Prerequisite: 92.501. (3,0)3

92.595 Information Theory

Shannon theory including information measure and transmission rates and capacities. Elements of coding theory. Prerequisite: 92.501. (3,0)3

92.596 Finite Elements

Mathematical formulations and techniques including an introduction to variational methods. Examples from solid mechanics, heat transfer, and fluid mechanics. Prerequisite: 92.501. (3,0)3

92.599 Approximation Theory

Uniform approximation by polynomials. The Weierstrass and Jackson theorems. Characterization of best approximation. Least squares approximation. Approximation by splines and rational functions. Prerequisite: 92.501. (3,0)3

92.651,652 Directed Studies I, II

Intended to satisfy individual student needs. Topics include various fields of mathematics. Prerequisite: permission of instructor and graduate coordinator. (3,0)3, (3,0)3

92.653,660 Selected Topics I, II

Advanced topics in various fields of mathematics and related fields. Since topical coverage varies from term to term, a student may be allowed to receive credit more than once for this course. Prerequisite: permission of instructor. (3,0)3

Department of Philosophy

Robert E. Innis, Chairperson

Professors: Robert E. Innis, R. Eugene Mellican, Arthur I. Miller (Emeritus), P. Christopher Smith

Associate Professors: Robert B. Wagner

Assistant Professors: Jane Freimiller

The Philosophy program through its emphasis on critique (its role as a Socratic gadfly) and on the examination of the twin fundamental issues of human life, meaning and action, links the arts, the sciences, and the humanities. It occupies an integral and essential place in both the College of Arts and Sciences and the University. The Philosophy program illustrates through specific courses how philosophical ideas have influenced other disciplines and how it has been illuminated by the intellectual visions expressed through those disciplines. Serious contact with the discipline of philosophy sharpens critical thinking, clarifies values, and helps to produce articulate, intellectually prepared, and adaptable individuals ready to lead contemporary society in a socially responsible manner.

The Philosophy Department has structured its course offerings so that they appeal to majors and non-majors alike: courses intersect with issues and problems treated in other disciplines, from the natural sciences through engineering to the social sciences and the other humanities. The Department especially shows the interrelationships between different areas of knowledge and also between different areas of existence, both individual and social. It aims to counteract the fragmentation of knowledge that is a mark of modernity. Consequently, the Philosophy courses are designed to appeal to the broadest range of students and to continue philosophy's traditional role as an indispensable integrator in the University curriculum.

The Department of Philosophy offers a major in Philosophy which leads to the Bachelor of Arts degree. The Department also offers a minor in Philosophy.

COLLEGE OF ARTS AND SCIENCES

Department of Philosophy

Philosophy Major

The major in Philosophy is designed to serve the needs of three types of students: 1) those who seek a liberal arts education as a terminal program; 2) those who are preparing for professional graduate schools, e.g., education, law, theology, and medical schools which approve an undergraduate philosophy major; and 3) those who are preparing for graduate work in philosophy. A Philosophy major is of value to all who question the reasons for things as they are, to those who seek a deeper understanding of what they are doing and their purpose for doing it, and to those who recognize the validity of Socrates' assertion that the "unexamined life is not worth living."

A major in Philosophy consists of 30-45 credits (with at least 15 credits at the 300 level or above). The Department does not specify particular course work for the major but recommends that the sequence of courses be designed in close consultation with the student's faculty advisor. Students who plan to go to graduate school are encouraged to take a second major in a cognate field, e.g., American Studies, English, French, History, Mathematics, or Political Science.

Communications and Critical Thinking Option

The Philosophy Department also offers an interdisciplinary option in "Communications and Critical Thinking" within the Philosophy major, leading to the Bachelor of Arts degree. This program serves students looking to increase their professional options within such fields as publishing, public relations, advertising, sales and marketing, and social services, and who want an interdisciplinary course of study that transcends the confines of traditional programs. The program also provides excellent preparation for further graduate study, above all, in law and business.

Students transferring into the College who wish to major in Philosophy must make individual arrangements with the chairperson of the Department of Philosophy regarding satisfaction of major course requirements.

Philosophy Minor

A minor area of study consists of 18-24 credits of coursework in Philosophy. At least six credits must be selected from courses which are numbered 300 or above.

General Requirements

For students entering the University in Fall 1993 and subsequently

Freshman Year

Fall Semester

42.101	College Writing I (Gen Ed)	3
92.	Mathematics** (Gen Ed)	3
45.	Philosophy Elective	3
	General Education Course***	3
	Beginning Language I	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	General Education Course***	3
	General Education Course***	3
45.	Philosophy Elective	3
	Beginning Language II	3
		15

Sophomore Year

Fall Semester

45.	Philosophy Elective	3
45.	Philosophy Elective	3
	General Education Course***	3
	General Education Course***	3
	Intermediate Language I	3
		15

Spring Semester

45.	Philosophy Elective	3
45.	Philosophy Elective (300 level or above)	3
	General Education Course***	3
	General Education Course***	3
	Intermediate Language II	3
		15

Junior Year

Fall Semester

45.	Philosophy Elective (300 level or above)	3
45.	Philosophy Elective (300 level or above)	3
	General Education Course***	3
	General Education Course***	3

Free Elective	3
	15

Spring Semester

45.	Philosophy Elective (300 level or above)	3
45.	Philosophy Elective (300 level or above)	3
	Philosophy or Free Elective	3
	Free Elective	3
	Free Elective	3
		15

Senior Year

Fall Semester

	Philosophy or Free Elective	3
	Philosophy or Free Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

	Philosophy or Free Elective	3
	Philosophy or Free Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

*36 credits are recommended for students planning to attend graduate school

**Refer to the Academic Policies section of this catalogue for Gen Education requirements in mathematics

***The remaining Gen Education requirements include: two courses in Behavior and Social Studies, one course in Historical Studies, one course in Literature, one course in Values, Concepts and Choice, one course in Aesthetics and three courses in the Sciences, two of which must include some form of experimental learning such as a laboratory. Consult the Academic Policies section of this catalogue for approved lists of General Education courses.

Communications & Critical Thinking Option

A Philosophy major with a Communications & Critical Thinking Option consists of 30-36* credits. The department does not specify course work for the major but recommends that the

Department of Philosophy

sequence of courses be designed in close consultation with the student's faculty advisor.

The option in Communications & Critical Thinking is designed to serve the needs of three types of students:

- 1.) those who seek an interdisciplinary course of study that transcends the confines of traditional programs;
- 2.) those who are looking to increase their professional options within such fields as publishing, public relations, advertising, sales and marketing, and social services;
- 3.) those who are preparing for further graduate study especially in business and law.

Freshman Year**Fall Semester**

42.101	College Writing I (Gen Ed)	3
92.	Mathematics (Gen Ed)	3
45.203	Intro. to Ethics**	3
	Historical Studies (Gen Ed)	3
	Beginning Language I	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
91.113	Exploring the Internet	3
	Beh & Soc St (Gen Ed)	3
45.202	Intro to Logic & Crit Reason**	3
	Beginning Language II	3
		15

Sophomore Year**Fall Semester**

	Group A Elective (Crit. Theory)	3
	Group B Elective (Pract. Appl.)	3
	Science w/lab (Gen Ed)	3/4
	Beh & Soc St (Gen Ed)	3
	Intermediate Language I	3
		15/16

Spring Semester

	Group A Elective	3
	Group B Elective	3
	Science w/lab (Gen Ed)	3/4
	Literature (Gen Ed)	3
	Intermediate Language II	3
		15/16

Junior Year**Fall Semester**

	Group A Elective	3
	Group B Elective	3
	Free Elective***	3
	Values, C & C (Gen Ed)	3
	Minor Elective	3
		15

Spring Semester

	Group A Elective	3
	Free Elective	3
	Free Elective***	3
	Aesthetics (Gen Ed)	3
	Minor Elective	3
		15

Senior Year**Fall Semester**

3400/400 level	Minor Elective	3
	Group A Elective	3
	Practicum Exper/Dir BA Thesis	3
	Free Elective	3
	Minor Elective	3
		15

Spring Semester

300/400 level	Minor Elective	3
	Free Elective	3
	Group A or B Elective	3
	Free Elective	3
	Minor Elective	3
		15

*36 credits are recommended in order to be eligible for graduate school.

**Strongly recommended, but not required.

***It is recommended that students continue with foreign language studies through advanced level.

Approved Elective Courses for Groups A and B**Group A (Critical Theory) Electives - choose at least 5**

45.354	Classical Rhetoric & the Theory of Argument,
45.305	Language, Signs, & Symbols,
45.301	Theory of Knowledge,
47.365	The Psychology of Language,
45.309	Logic & Language,
50.315	Cultural Intro to the Languages of Europe,

42.307	History & Dev. of English,
42.308	Analysis of Modern English,
45.325	Critical Thought: Hegel, Marx, Marcuse,
42.429	Critical Theory & Interpretation,
45.343	Hermeneutics & Deconstruction,
45.384	Philosophies of Art & Beauty,
45.311	The History and Theory of Film,
52.378	Italian Cinema and Culture,
74.419	Theory & History of the Performing Arts,
46.315	Politics of Film,
78.301	Music, Tech., & Soc.,
45.335	Ethical issues in Tech.,
45.329	Environmental Ethics,
48.260	Sociology of Mass Media.

Group B (Practical Application) Electives - choose at least 3

	Applications of New Technology, Communication Needs Intersect with Cybertexts,
42.391	Business Communication,
42.229	Essay Writing, Uses of Multimedia,
42.300	Journalism,
42.387	Editing & Publishing, Theory & Practice of Camera Vision,
	Computer Graphics & Visual Communication by Design,
42.261/262	Acting/Advanced Acting.

Philosophy Courses (Prefix: 45)**45.201 Introduction to Philosophy**

An examination of some of the typical approaches to philosophical questioning and the issues raised in such inquiry: what is knowledge, what is the good, what is the right political order, what is the nature of religious faith? 3 cr

45.202 Introduction to Logic

Designed to study the methods used to distinguish correct from incorrect argument. It aims at developing (1) an ability to express one's ideas clearly and concisely, (2) an increased skill in defining one's terms, and (3) a capacity to formulate arguments vigorously and to scrutinize them critically. 3 cr

45.203 Introduction to Ethics

An examination of the basic issues and problems of ethics and value and a survey of some important traditional and alterna-

COLLEGE OF ARTS AND SCIENCES*Department of Philosophy*

tive answers to the questions raised, on both an individual and a social level, by our necessity to act and to live in a rational and human way. 3 cr

45.206 Introduction to Political Philosophy

Revolutionary and conservative tendencies in the history of political philosophy are compared and their development traced. Such political theorists as Plato, Aristotle, Aquinas, Hobbes, Locke, Marx, Burke, Mill, and Rawls are considered. 3 cr

45.215/220 Studies in the History of Philosophy

Great figures, periods, or problems in the history of philosophy are subjected to an extensive, semester long examination. 3 cr

45.293 Plato and the Beginnings of Philosophy

Concerned with Plato's attempt to deal with the questions raised by the first Greek philosophers. Particular attention is paid to Plato's teachings on logic, justice, eros, pleasure, and knowledge. 3 cr

45.296 The Religious Experience of Mankind

A study of religious knowledge and the phenomena of religion from a philosophical standpoint. The course considers explanations for religious behavior, some central issues in religious belief, and the values and goals of religious systems. Various world religions provide specific data for these topics. 3 cr

45.300 Philosophy and Society

An examination of the shifting nature of the chief material, symbolic, and normative premises of social, historical, and cultural processes. The course studies the interactions and intersections between the various formations in which human life objectifies itself, and investigates the tensions and distortions to which they are subject. 3 cr

45.301 Ways of Knowing

Studies and analyzes various forms and expressions of human knowledge (perception, concept-formation and symbolic functioning, myth, aesthetic creation and interpretation, scientific discovery and understanding) and the individual, social, and historical conditions to which they are subject. The goal of the course is a comprehensive view of the structure of the human mind and its operations. 3 cr

45.302 Existence and Anxiety

A survey of existential philosophy and literature with reference to the traditional philosophy which existentialism calls into question. Kafka, Camus, Buber, Rilke, Nietzsche, and Musil are discussed. 3 cr

45.303 Philosophy and Technology

A philosophically oriented, systematic examination of the chief aspects—material, economic, political, cultural, aesthetic, ethical—of the processes by which the human race creates and embodies itself in tools and instruments. 3 cr

45.304 God and Philosophy

Studies, historically and systematically, the following topics: a) the origin and content of the idea of God, b) the possibility of affirming God, philosophically and religiously, c) the complex nature of religious language and imagery, and d) God's relation to the world, history, and the individual. 3 cr

45.305 Language, Signs and Symbols

An examination of the various grammars of human expressions from the point of view of a general theory of signs. Among the topics to be treated are: a) the nature of signs, symbols, and meaning; b) the structures and functions of language; c) the relations between language, thought, and reality, especially as manifested in metaphor; d) the social dimensions of signification and symbolization; and e) the relations between the different linguistic, sign, and symbol systems. 3 cr

45.306 Religious Existentialism

In considering the works of Pascal, Kierkegaard, and Heidegger an attempt is made to work out a possible response to Nietzsche's radical challenge to the Judeo-Christian tradition. 3 cr

45.308 Philosophy of Law and Problems in Criminal Justice

An introduction to philosophical principles and theories underlying the institutions of law and criminal justice. Students: 1) study the purpose and functions of law in a democratic society; 2) examine the philosophical grounds for authority and legal obligation; 3) analyze and attempt to resolve the long standing dispute between the utilitarian and retributive theories of criminal justice; 4) evaluate the concepts of punishment, rehabilitation, and treatment in dealing with criminal behavior;

and 5) assess the philosophical basis of current problems and issues confronting the criminal justice system. 3 cr

45.309 Logic and Language

An examination of the role of language in logical reasoning. Special attention is given to the properly rhetorical elements in logical argumentation. General topics of logic are studied from a novel point of view. 3 cr

45.310 Philosophy of the Creative Imagination

Focuses first on imagination as a function of mind, placing it in relation to other functions such as perception, emotion, and conceptualization. Attention is then given to the difference between the reproductive and the creative imagination, with special emphasis on the psychological and social/political dimensions of creativity. Topics to be considered include poetical metaphor, theatrical performance, painting, architecture, or photography. 3 cr

45.312 Philosophy of Science

Explores ways in which science has been understood in different historical periods. An investigation is made of the kinds of propositions which are strictly scientific; the methods which are appropriate to scientific inquiry; and the nature, origins, and cultural implications of scientific revolutions. In addition, attention is given to certain key concepts (e.g., space, time, causality) which have played a central role in the history of science in order to correlate changes in these concepts with developments undergone by the notion of science as such. 3 cr

45.313 The Platonic Tradition

An exploration of the intertwining of the rational, mystic, philosophical, and poetic elements in Plato, Aristotle, Plotinus, St. Augustine, and Goethe. Examines the stages of consciousness as it moves through the limits of "scientific" understanding to re-unification with the divine. 3 cr

45.314 Philosophy and Science Fiction

A study of a variety of philosophical issues concerning knowledge, reality, the self, and society as exemplified in works of science fiction. 3 cr

45.315/324 Philosophical Classics

A close study of some of the great texts of philosophical literature. In general, one or two major works are selected and subjected to a thorough reading. 3 cr

Department of Philosophy

45.325 Critical Thought: Hegel, Marx, Marcuse

In pursuing critical thought the course will consider estrangement, alienation and dehumanization as these result from the commercialization of human relationships. Using Marcuse's *Reason and Revolution*, we will clarify the meaning of "critical," dialectical, "negative" thinking. We will turn next to Hegel's exposition in his *Phenomenology of Spirit* of "consciousness of self" as this develops through meaningful work. With recourse again to Marcuse's *Reason and Revolution*, we will apply the writings of the early Marx to understand how this development of "consciousness" to self-awareness is reversed when work becomes making money in one's own self-interest. At issue throughout will be what remains of "critical thought" in a Hegelian, Marxian sense once Hegel's and Marx's claim to absolute reason and knowledge has been destroyed (by Heidegger and others), and the limits of human understanding are acknowledged. 3 cr

45.326 Ethics and Business

Through the study and application of some of the fundamental concepts and principles of traditional and contemporary ethical theories, this course undertakes a philosophical analysis of the diverse and complex ethical issues confronting those engaged in the practice of business. 3 cr

45.330 Philosophy of Symbolic Logic

The first half of this course examines various axiomatic systems, and the student develops both intrasystematic and metasystematic techniques of proof. During the second half of the course, attention is given to certain important philosophical problems which arise from reflection on logical systems, e.g., the cognitive processes of abstraction and instantiation, the general notion of form, and questions of consistency and interpretation. 3 cr

45.331 Philosophy of Mind

The status of consciousness is the central concern of a philosophy of mind. The course takes as its point of departure a reflection upon the nature and significance of consciousness from the perspective of its advocates (Husserl, Sartre) and its adversaries (Ryle, Skinner). The results of this preliminary inquiry is to provide a foundation for the exploration of other issues: the possibility of an unconscious; the temptation of bad faith; the dynamics of concept formation; and the nature of emotion, imagination, and dreams. 3 cr

45.332 Cognitive Sources of Conflict

A study of the perceptual and cognitive biases as causes of conflict. Among the topics to be examined are: sources and mechanisms of personal bias; theories of the sociology of knowledge, cognitive dissonance, doubling, and prejudice; and implications for critical thought. 3 cr

45.333 Symbols and Society

The central task is the philosophical examination of a variety of social symbols (verbal, visual, and praxic) in terms of their relations to modes of social control or influence and to perceptions of social realities. This inquiry is carried out by exploring the dynamics of social symbols in traditional non-literate societies as well as in literate technological societies, in order to understand how people both affect and are affected by the symbol systems among which they live their lives. Topics to be considered include myth, folklore, painting, photography, advertising, and propaganda. 3 cr

45.334 Engineering and Ethics

A philosophical analysis of the ethical dimensions and responsibilities of the engineering profession. Specific case studies and ethical issues are analyzed through the application of some of the basic concepts and principles of traditional and contemporary ethical theories. 3 cr

45.335 Ethical Issues in Technology

Examines important ethical issues and value conflicts emerging in contemporary science and technology. Through readings and class discussions, students not only have the opportunity to explore the manner in which ethical and technical problems are related but also to develop insight into the problems of ethical philosophy and the modes of reasoning essential to an intelligent understanding of such issues. 3 cr

45.337 Science and the Meanings of Nature

The historical and conceptual significance of the rise of the modern sciences of nature and their impact upon our models of knowing, self, and society. 3 cr

45.340 Mysticism East and West

A study of the varieties of mystical and religious experiences and their power to uncover fundamental features of human existence. 3 cr

45.341 Science, Ethics, and Society

The ethical problems and issues (personal, social, political, medical, environmental) attendant upon the rise of science and scientific rationality and their pre-eminent place in society. 3 cr

45.342 Critical Theory of Society

The mature and methods of a critique of society that focuses on the conflicts between the various modes of rationality and rationalization. 3 cr

45.343 Hermeneutics and Deconstruction

A comparative treatment of these two postmodern methods of interpretation with regard to their implications for political theory and practice. 3 cr

45.344 The Idea of Nature

The changing contents and the changing epistemological, social, aesthetic, economic, and religious implications of the concept of nature. 3 cr

45.354 Classical Rhetoric and the Theory of Argumentation

Recent insights into the limits of traditional logic have confirmed that Aristotle was correct when, in distinguishing between the logical syllogism and the rhetorical enthymeme, he implied that in any field of argument outside the pure mathematical sciences there are no certain starting points and no final conclusions and, accordingly, the more useful model would be public speech and discussion, not inference and deduction. In examining the texts of the ancient masters of rhetoric, Aristotle, Cicero, and Quintilian, this course takes up their reflections on the nature of effective argument—forensic, epideictic, and deliberative—and thereby attempts to lay bare the foundations of contemporary rhetorical theories. 3 cr

45.384 Philosophies of Art and Beauty

Examines the views of major philosophers on the beautiful and the nature of artistic creativity. An attempt is made to correlate the views of the thinkers with the works of poets, artists, and composers and the statements the latter have made about their work. 3 cr

COLLEGE OF ARTS AND SCIENCES*Department of Physics and Applied Physics***Directed Studies**

Directed studies courses are available only to majors in Philosophy and may be elected provided that 1) the material to be covered is not available in any course offered during the semester in which a directed studies course is contemplated, 2) instructors are willing to undertake a directed studies course, and 3) no more than nine hours of credit in the major field is acquired through registration for and completion of directed studies courses.

45.491 Directed Study in Philosophy

The student, through regular and frequent consultation with an instructor, pursues a special problem in philosophy, the results of which are presented in a 25-30 page paper. Prerequisite: permission of instructor. 3 cr

45.495 Advanced Tutorial in Philosophy

A program of directed study which provides the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate an additional problem. The purpose is to sharpen and refine techniques for scholarly research and presentation. Prerequisite: demonstrated proficiency in an area selected for directed study and permission of instructor. 3 cr

Department of Physics and Applied Physics

Dr. James J. Egan, Chairperson

Dr. Arthur Mittler, Undergraduate Coordinator

Dr. Gus P. Couchell, Graduate Coordinator

Professors: Albert Altman, Adolph Baker (Emeritus), Leon E. Beghian (Emeritus), George L. Carr (Emeritus), George E. Chabot, Gus P. Couchell, James J. Egan, Zoltan Fried, William D. Goodhue, F. Raymond Hardy (Emeritus), Padmanabh Harihar, F. Raymond Hardy (Emeritus), Jesse Harris (Emeritus), Lloyd Kannenberg, Aram S. Karakashian, Gunter H.R. Kegel, Jayant Kumar, David M. Larsen, Anthony Liuzzi (Emeritus), Suresh C. Mathur (Emeritus), Arthur Mittler, David J. Pullen, Paul J. Ring (Emeritus), Walter A. Schier, Kunat Sebastian, Eric Sheldon (Emeritus), Kenneth W. Skrable (Emeritus), Richard W. Stimets, Ye Yung Teng, Jerry Waldman, Martin Wilner, Francis Worrell (Emeritus)

Associate Professors: Partha Chowdhury, Clayton S. French Jr., Thomas V. Marcella (Emeritus), Roger D. McLeod, Walter K. Mellen (Emeritus), Paul J. Ring (Emeritus), Alexander Sachs, Chuen Wong

The Bachelor of Science (B.S.) degree offered in Physics is intended to prepare a student for a career in industry or graduate study in a number of fields by providing him/her with a flexible course of study which superimposes a specialization chosen by the student (at least 13 credits of technical electives) on a general physics foundation (47 credits of required courses in the Kernel). At least 53 credits total must be taken in physics courses to satisfy the requirements for the B.S. in Physics. Some of the technical electives may be chosen from appropriate courses outside the Department or from the list of Physics Elective courses. The elective courses in physics include the optics courses (13 credits) required for the Optics Option. There are four courses of study available: Most Flexible, Optics Option, Radiological Health Physics field Option, and preparation for Graduate School. Successful completion of either option program will be certified by the Department on the student's transcript.

The Bachelor of Science in Physics

Physics is the science of matter and is concerned with its fundamental structure, properties and behavior. The fields of chemistry, biology, geology, astronomy and engineering, among others, draw upon physics for their basic understanding.

A present day physicist engages in research, development and design, teaching or administration. The employer may be an educational institution, a small business, a large industrial firm, a government laboratory or a non-profit research center. Those physicists who obtain a doctorate (Ph.D.) are prepared for a research career and are expected to have a high level of initiative with responsibility for a research program. This program can fall anywhere in the range from "basic" through "applied" depending upon one's interests and those of his/her employer. The physics program is designed to give the student a continuum of career choices.

Accordingly, the University of Massachusetts Lowell program can prepare students for a research career. The required and elective courses develop a sound understanding of the principles of experimental and theoretical physics and can successfully prepare the physics major for graduate study. The program also accommodates students who will seek employment after receiving the Baccalaureate degree. It allows these students to develop a remunerable talent in some specialized field. This is possible because of the number of technical electives in the curriculum. Through these electives the student acquires at least 13 credits in some field of specialization.

The program is very flexible allowing the student to match his/her special interests with the study of physics. Specialties may be as far afield as economics or management or as close as mathematics or chemistry. They may be in any of the engineering fields or computer science. A student pursuing this course of study develops a solid foundation in physics and concurrently acquires a good background in a specialized field thereby obtaining the necessary practical knowledge to solve applied problems competently.

This combination of the general and the specialization prepares the student for immediate employment after graduation.

Department of Physics and Applied Physics

Some graduates of this program have chosen industry, government work, or teaching. While such business employment may be the primary goal of the student, it is also possible to pursue graduate studies in either the specialized field or physics.

Students who complete the undergraduate program in physics often receive awards for complete support for graduate study. In the past, graduating seniors have received awards of complete tuition for graduate study and additional stipends from graduate schools such as Harvard University, the University of Chicago, Brown University, the University of Illinois, Johns Hopkins University, Brandeis University, Purdue University, the State University of New York at Stony Brook, Boston University, the University of Maryland, Rochester University, University of Arizona and Rensselaer Polytechnic Institute.

Optics Option

Majors in the Department of Physics and Applied Physics may also elect an Optics Option which will be recognized on the student's transcript providing an official declaration form is filed at the end of the lower division program. This option will provide the student with intensive training in optics in preparation for immediate entry into a career in one of the many rapidly expanding fields in optics such as optical component and system design, lasers, and image processing. In addition, students wishing to continue their training will be qualified to enter graduate study in physics, optics, astronomy or engineering.

This option has been developed by the Department of Physics and Applied Physics in consultation with an Industrial Advisory Panel of distinguished physicists active in various fields of optics in order to fill a need in the New England area for graduates at the B.S. level with a strong background in optics. Students enrolled in the Optics Option will have an excellent chance of finding summer or part-time employment in the optics industry during their junior and senior years.

The topics which will be covered in the courses offered under the Optics Option include the basic principles of geometrical optics and their application to the design of optical components and systems such as lenses, microscopes and telescopes, the

design and operation of optical devices such as lasers, spectrometers and interferometers, the generation and detection of various types of electromagnetic radiation, optical properties of materials and the properties of imaging systems and image processing. There will be extensive laboratory work associated with the courses utilizing state-of-the-art equipment.

Radiological Health Physics Option

Radiological health physics involves the study of the effects of radiation and radioactivity on life processes. It also can be called radiation protection science and is particularly involved with the effects of radiation on the human body and the control of such radiation.

A graduate of this curriculum would enter the profession of health physics, which is devoted to the protection of human beings and their environment from radiation hazards, while at the same time making it possible for our advancing civilization to enjoy all of the benefits resulting from uses of radiation.

Radiation control in its professional aspects incorporates an understanding of many disciplines. It has common scientific interests with many areas of specialization: biophysics, physics, biochemistry, chemistry, biology, genetics, ecology, nuclear engineering, metallurgy, medicine, physiology, and toxicology. Other aspects of the profession include working knowledge of labor relations, public relations, teaching, philosophy, and administration. The wide spectrum of knowledge required of the health physicist makes this profession both challenging and rewarding.

Health physicists are employed by federal agencies (such as the Nuclear Regulatory Commission and Department of Energy) at research, production, and testing facilities; state, and local government agencies responsible for regulating the use of radioactive materials; the military services; electric utilities operating nuclear power plants; businesses which use radioisotopes or x-ray equipment to detect flaws or defects in manufactured products, prepare or reprocess nuclear fuels, control nuclear wastes, or produce or use radioactive materials or devices; universities (in teaching, research, and equipment monitoring); hospitals and medical centers that use radionuclides, x-ray equipment, and

accelerators in the diagnosis and treatment of patients; and consulting firms which advise the service installations that do not employ full-time health physicists.

Scholarships are available for undergraduate students who choose the Radiological Health Physics Option. These are available from the Nuclear Regulatory Commission, the Department of Energy, the Health Physics Society, the National Academy for Nuclear Training, and other organizations concerned with radiation protection. All students in the Radiological Health Physics Option who have completed the required sophomore year courses currently receive a \$500 scholarship from funds donated by Northeast Utilities Service Company of Hartford, Connecticut. These scholarships have been sponsored to attract highly qualified young men and women into the much needed field of radiation protection sciences.

The Radiological Health Physics students enjoy excellent job opportunities and challenging careers in the radiation protection field upon graduation. Students may gain valuable applied work experience while also earning much needed money through various summer internship programs at the University of Massachusetts Lowell. They also may gain experience and academic credit through an internship course at the University Radiation Laboratory. This course is conducted under the direction of the health physics staff who have responsibility for the radiation safety programs at the nuclear reactor facility, accelerator facility, radioisotope research laboratories and x-ray facilities at the University of Massachusetts Lowell. The academic and job experience that the students receive provide excellent preparation for either an applied health physics position or the pursuit of an advanced degree in radiation protection or related fields. The University of Massachusetts Lowell offers, as well as the B.S. program, both M.S. and Ph.D. programs in radiological sciences and protection and receives research and scholarship support from government and industry. Radiological Health Physics graduates at all degree levels are receiving many high-salaried job opportunities.

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Department of Physics and Applied Physics

Five-year B.S./M.S. Program in Radiological Sciences

In recognition of the need for advanced training beyond the bachelor of science level in radiological sciences, the following represents a program by which outstanding undergraduates can pursue an accelerated five-year course of study leading to the B.S. and M.S. degrees in Radiological Sciences.

1. Undergraduate students who express an interest in this program will be evaluated by the graduate selection committee. Those students deemed commendable by the committee will be advised relative to the correct procedure for successful completion of their B.S. degree, as well as a course of study toward the M.S. degree.

2. The first three years of undergraduate study will be identical to that which is specified for students enrolled in the current four year B.S. program.

3. During the second semester of the junior year and upon approval and recommendation by the graduate selection committee, the student will file formal application to the Graduate School. This does not require the student to have taken the Graduate Record Examination. The committee decision will be based on; a) overall grade-point average, b) grade-point average in selected subjects, c) recommendations by program faculty, and d) a one year minimum residency requirement at the University of Massachusetts Lowell. Upon approval and recommendation by the Dean of the Graduate School, the student may be allowed to pursue graduate studies during the Senior year and officially become a provisional graduate student in the first semester of senior year.

4. During the senior year, the student will be permitted to take up to four graduate-level courses which can be applied towards the M.S. degree. Although advanced undergraduate (i.e., 400 level) courses are acceptable, no more than two such courses will be allowed towards the M.S. degree. It should be emphasized that the total number of credits for the combined degrees must be greater than the minimum number of credits required for both the undergraduate and graduate degrees. The University B.S. requirement is 120 credits, thus a student with a total of 124 credits may, with approval, transfer up to four of the credits used to obtain the B.S. degree toward the M.S. degree.

A maximum of 12 credits can be transferred toward the M.S. degree program.

5. Upon completion of the fourth year of study, assuming that all program and University requirements have been met, the student will be awarded the B.S. degree and may then be recommended for full matriculation status by the graduate selection committee and the Dean of the Graduate School prior to the fifth year of study. If the student chooses not to continue toward the M.S. degree (or fails the fifth year), this does not alter receipt of the B.S. degree.

6. Although the options exist for taking an overload in any semester and/or registration for one or more summer sessions, they are not a requirement of this program. However, students wishing to gain a full research experience will be encouraged to initiate their research as early as possible (e.g., during the junior to senior year summer session), which is a distinct advantage of this accelerated program.

7. During the fifth year, as in the standard M.S. degree program, the student may undertake: a) thesis option (nine semester hours of graduate research) or b) project option (three semester hours of graduate project). In either case, the student will be required to take two one-credit graduate seminar courses, as well as the other courses required for the M.S. degree in radiological sciences, and must satisfy the 30 credit minimum M.S. degree requirement. Upon completion of all program and graduate school requirements, the student will be awarded the M.S. degree.

Kernel Program

The courses listed below constitute the required Kernel for all physics majors. Sample programs of study are shown in the next section which illustrate how these courses can be integrated with General Education requirements and Physics Electives to make a four-year degree program.

I. Lower Division Courses

Physics

95.112	Fresh Phys Sem	1 cr
95.161	Honors Physics I	4 cr
95.164	Honors Physics II	4 cr
95.269	Honors Physics III	4 cr
96.161	Honors Phys I Lab	2 cr
96.164	Honors Phys II Lab	2 cr
95.210	Intro Modern Physics	3 cr

96.260	Phys Instr	2 cr
96.295	Interm Exper Phys	2 cr

Non-Physics

42.101	College Writing I	3 cr
42.102	College Writing II	3 cr
84.121	Chemistry I	3 cr
84.122	Chemistry II	3 cr
84.123	Chemistry I/II Lab	1 cr
84.124	Chemistry II Lab	1 cr
92.131	Calculus I	4 cr
92.132	Calculus II	4 cr
92.231	Calculus III	4 cr
92.234	Differential Equations	3 cr

II. Upper Division Courses*

Physics

95.310	Quantum Physics	3 cr
95.338	Optics and Waves	3 cr
95.353	Elect - Magn I	3 cr
96.393	Adv Exper Phys I	2 cr
96.394	Adv Exper Phys II	2 cr
95.411	Sen Phys Sem	1 cr
95.413	Mechanics	3 cr
95.421	Statistical Thermo	3 cr
95.452	Contemporary Physics	3 cr

Non-Physics

92.301	Applied Math I	3 cr
92.302	Applied Math II	3 cr

Any waivers or substitutions for these requirements must be approved by the Undergraduate Coordinator.

*Upon completion of the Lower Division courses (Freshman and Sophomore Level) the students' records will be reviewed by a committee of at least three faculty members. A recommendation will be made to proceed to Upper Division courses (Junior and Senior Level) or to take remedial courses or repeat courses as deemed necessary to prepare the student for the Upper Division courses. A revised program will be formulated for each student requiring remedial work which may extend his/her program by one or more semesters. In appropriate cases the student will be advised to change major. The student attains the status of physics baccalaureate degree candidate when admitted to the Upper Division.

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Non-Physics Electives and General Education Requirements

In addition to the Kernel Program in Physics, courses to satisfy the General Education requirement and the physics elective requirement must be chosen from among all of the course offerings of the University subject to the following conditions:

1. All elective courses must be approved by the student's faculty advisor.
2. General Education requirement
 - a. college writing: two courses, six credit hour
 - b. literature: one course, three credit hours
 - c. historical studies: one course, three credit hours
 - d. aesthetics: one course, three credit hours
 - e. social and behavior studies: two courses, six credit hours
 - f. values, concepts, and choice: one course, three credit hours
 - g. mathematics: one course, three credit hours (met by the required mathematics courses)
 - h. sciences: three courses, nine credit hours minimum - at least two courses that include experimental learning (met by the required science courses)
3. Technical electives required by the major

At least 13 credits (of which six must be from the Physics Electives list) in technical elective courses must be taken in a specialty field. These electives may include courses outside the department. Elect - Magn II (3) [95.354] is strongly recommended for students intending to pursue a graduate degree in physics, as well as Introductory Quantum Mechanics I and II (3,3) [95.435/436]. Experimental Analysis for Physicists (1) [95.191] is required for students who have not taken 96.161 and 96.164 and have an insufficient background in experimental error analysis.

If the Optics Option is chosen, then included in the Physics Electives the student must take the courses listed below.

95.337	Geometrical Optics	3 cr
96.337	Geometrical Optics Lab	2 cr
96.338	Physical Optics Lab	2 cr
95.439	Electro-Optics w Lab	4 cr
95.440	Image Processing	4 cr

Successful completion of the Optics option will be certified by the Department on the student's transcript provided an official declaration form is filed at the end of the lower division program. See Physics Electives list for additional courses in optics.

Physics Electives**1. General Physics - Upper Division**
(all but 95.191)

95.191	Exp Anal for Physics Majors**	1 cr
95.212	Sophomore Physics Seminar	1 cr
95.312	Junior Physics Seminar	1 cr
95.354	Elect - Magn II*	3 cr
95.383	Astronomy & Astrophysics I	3 cr
95.384	Astronomy & Astrophysics II	3 cr
95.435	Intro Quantum Mechanics I	3 cr
95.436	Intro Quantum Mechanics II	3 cr
95.461	Nuclear Physics I	3 cr
95.472	Solid State Physics	3 cr
95.483	Relativity and Cosmology	3 cr
95.484	Relativity and Cosmology	3 cr
95.494	Elementary Particle Theory	3 cr
96.497	Senior Thesis	3 cr
96.498	Senior Thesis	3 cr
95.605	Mathematical Physics I	3 cr
95.606	Mathematical Physics II	3 cr

Note: *Courses that are strongly recommended for students intending to pursue a graduate degree in physics.

**Experimental Analysis for Physics Majors (1) [95.191] is required for students who have not taken 96.161 and 96.164 and do not have a background in experimental error analysis and technical report writing.

2. Optics - Upper Division

95.337	Geometrical Optics	3 cr
96.337	Geometrical Optics Lab	2 cr
96.338	Physical Optics Lab	2 cr
95.439	Electro-Optics w Lab	4 cr
95.440	Image Processing	4 cr
95.447	Laser Physics & Applic	3 cr
96.447	Experimental Laser Optics	2 cr
95.451	Fiber Optics	4 cr
96.453	Optics Project***	3 cr
96.454	Optics Project***	3 cr

***supervisor needed before registering

3. Radiological Health Physics

Upper Division

95.355	Phys of Rad & Nucl	4 cr
95.401	Rad Safety & Control I	4 cr
95.402	Rad Safety & Control II	4 cr
95.411	Radiochemistry	3 cr
95.422	Env Rad & Nucl Site Cri	3 cr
95.462	Radiation Biology	3 cr
95.481	Math Methods of Rad Sci	3 cr
95.482	Numerical Methods in RS	3 cr
96.306	Nuclear Instrumentation	4 cr

Electives (definitions)

Gen Ed Elect - general education elective
Physics Elect - physics elective - upper division

Special Elect - specialty elective (specialization)

Elective - free elective

The Physics Minor

A student who has a basic background in physics and mathematics may be able to take more advanced physics courses. The goal of the physics minor program is to provide recognition for students in other majors who wish to enhance their understanding and mastery of a broader range of subjects than is provided in their major field alone.

The physics minor will establish the physics background needed to enter interdisciplinary fields such as Biophysics, Medical Physics or Material Science. In addition, a physics minor would be especially useful for students majoring in Biology, Chemistry, Mathematics, Earth Sciences, Engineering or Computer Science.

A minor in Physics consists of a minimum of 22 credits of physics courses.

All course prerequisites and corequisites must be satisfied. The requirements for the minor are:

Lower Division

A. Students must earn nine credits by completing either of the following physics sequences:

95.141	Physics I	3 cr
95.144	Physics II	3 cr
95.245	Phys.Prop.of Mat.	3 cr
	or	

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Department of Physics and Applied Physics

95.161	Honors Physics I	4 cr
95.164	Honors Physics II	4 cr
95.269	Honors Physics III 4 cr	

B.

96.141	Physics I Lab	1 cr
96.144	Physics II Lab	1 cr
	or	
96.161	Honors Phys I Lab	2 cr
96.164	Honors Phys II Lab	2 cr

C. one of the following:

96.260	Phys Instr	2 cr
96.295	Interm Exper Phys 2 cr	

D.

95.210	Intro Modern Physics	3 cr
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Upper Division

E. Six cr. at or above 300 level	6 cr
Total Minimum	22 credits

Bachelor of Science Degree in
Physics Course of Study with
the Most Flexible choice of
courses

Freshman Year

Fall Semester

95.161*	Honors Physics I	4
96.161	Honors Phys I Lab	2
42.101	College Writing I	3
92.131	Calculus I	4
	Gen Ed Elect	3

(6) 16

Spring Semester

95.112	Fresh Phys Sem	1
95.164*	Honors Physics II	4
96.164	Honors Phys II Lab	2
42.102	College Writing II	3
92.132	Calculus II	4
	Gen Ed Elect	3

(7) 17

Sophomore Year

Fall Semester

95.269*	Honors Physics III	4
96.295	Interm Exper Phys	2
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.231	Calculus III	4
	Gen Ed Elect	3

(6) 17

Spring Semester

95.210	Intro Modern Physics	3
96.260	Phys Instr	2
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.234	Differential Equations	3
	Elective	1

(5) 13

Junior Year

Fall Semester

95.353	Elect - Magn I	3
96.393	Adv Exper Phys I	2
92.301	Applied Math I	3
	Gen Ed Elect	3
	Gen Ed Elect	3

(5) 14

Spring Semester

95.310	Quantum Physics	4
95.338	Optics and Waves	3
96.394	Adv Exper Physics II	2
92.302	Applied Math II	3
	Spec Elect	3
	Spec Elect	1

(8) 16

Senior Year

Fall Semester

95.411	Sen Phys Sem	1
95.413	Mechanics	3
95.421	Statistical Thermo	3
	Spec Elect (PH)	3
	Gen Ed Elect	3

(7) 13

Spring Semester

95.452	Contemporary Physics	3
	Spec Elect (PH)	3
	Spec Elect	3
	Elective	3
	Elective	3

(3) 15

Total Program Requirement 120 credits

KERNEL = 47 physics credits, major field
requirement = 60 credits, SPECIALIZA-
TION = 13 credits (6 must be in physics)* alternative introductory calculus-based
physics courses may be substituted with
departmental approval

() number of specified physics credits.

Course of Study for Optics
Option

Freshman Year

Fall Semester

95.161*	Honors Physics I	4
96.161	Honors Phys I Lab	2
42.101	College Writing I	3
92.131	Calculus I	4
	Gen Ed Elect	3

(6) 16

Spring Semester

95.112	Fresh Physics Sem	1
95.164*	Honors Physics II	4
96.164	Honors Phys II Lab	2
42.102	College Writing II	3
92.132	Calculus II	4
	Gen Ed Elect	3

(7) 17

Sophomore Year

Fall Semester

95.269*	Honors Physics III	4
96.295	Interm Exper Phys	2
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.231	Calculus III	4

(6) 14

Spring Semester

95.210	Intro Modern Physics	3
96.260	Phys Instr	2
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.234	Differential Equations	3
	Gen Ed Elect	3

(5) 15

Junior Year

Fall Semester

95.337	Geom Optics	3
95.353	Elect - Magn I	3
96.337	Geom Optics Lab	2
96.393	Adv Exper Phys I	2
92.301	Applied Math I	3
	Gen Ed Elect	3

(10) 16

Spring Semester

95.310	Quantum Physics	3
95.338	Optics and Waves	3
96.338#	Physical Optics Lab	2
92.302	Applied Math II	3
	Gen Ed Elect	3

(8) 14

Senior Year**Fall Semester**

95.411	Sen Phys Sem	1
95.413	Mechanics	3
95.421	Statistical Thermo	3
95.439	Electro-Optics w Lab	4
	Gen Ed Elect	3
		(11) 14

Spring Semester

95.440	Image Proc & Lab	4
95.452	Contemporary Physics	3
	Elective	3
	Elective	3
	Elective	1
		(7) 14

Total Program Requirement 120 credits

KERNEL = 47 physics credits, major field requirement = 60 credits, SPECIALIZATION = 13 credits (6 must be in physics)

* alternative introductory calculus-based physics courses may be substituted with departmental approval

96.338 substitutes for 96.394 with respect to the Kernel

() number of specified physics credits

Course of Study for Radiological Health Physics Option

Freshman Year**Fall Semester**

95.161#	Honors Physics I	4
96.161	Honors Phys I Lab	2
42.101	College Writing I	3
92.131	Calculus I	4
	Gen Ed Elect	3
		(6) 16

Spring Semester

95.112	Fresh Physics Sem	1
95.164#	Honors Physics II	4
96.164	Honors Phys II Lab	2
42.102	College Writing II	3
92.132	Calculus II	4
	Gen Ed Elect	3
		(7) 17

Sophomore Year**Fall Semester**

95.269#	Honors Physics III	4
96.295	Interm Exper Phys	2
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.231	Calculus III	4
	Gen Ed Elect	3
		(6) 17

Spring Semester

95.204	Intro Rad Sciences	3
96.260	Phys Instr	2
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.234	Differential Equations	3
92.263	Fortran Prog or	
92.265	Pascal Prog	3
		(5) 15

Junior Year**Fall Semester**

95.355	Phys Rad & Nucl	3
95.481	Math Meth RS	3
81.111	Princ Biology I*	3
92.386	Stat for Sci/Eng	3
	Gen Ed Elect	3
		(6) 15

Spring Semester

95.306	Nucl Instr	4
95.482	Num Meth RS	3
81.112	Princ Biology II**	3
81.252	Physiology***	3
81.254	Physiology Lab***	1
		(7) 14

Senior Year**Fall Semester**

96.301	H P Intern I	3
95.401	Rad Saf & Contr I	4
	Gen Ed Elect	3
	Elective	3
		(7) 13

Spring Semester

95.402	Rad Saf & Contr II	4
96.462	Radiation Biology	3
	Gen Ed Elect	3
	Elective	3
		(5) 13

Total Program Requirement 120 credits

alternative introductory calculus-based physics courses may be substituted

with departmental approval

* alternative 93.101/3 Life Science I & Lab (4 credits for 3)

** alternative 83.102/4 Life Science II & Lab (4 credits for 3)

***alternative 35.101/4 Anatomy & Physiology I/II (8 credits for 4)

() number of specified physics credits

Course of Study in Preparation for Graduate School in Physics

Freshman Year**Fall Semester**

95.161*	Honors Physics I	4
96.161	Honors Phys I Lab	2
42.101	College Writing I	3
92.131	Calculus I	4
	Gen Ed Elect	3
		(6) 16

Spring Semester

95.112	Fresh Phys Sem	1
95.164*	Honors Physics II	4
96.164	Honors Phys II Lab	2
42.102	College Writing II	3
92.132	Calculus II	4
	Gen Ed Elect	3
		(7) 17

Sophomore Year**Fall Semester**

95.269*	Honors Physics III	4
96.295	Interm Exper Phys	2
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.231	Calculus III	4
	Gen Ed Elect	3
		(6) 17

Spring Semester

95.210	Intro Modern Physics	3
96.260	Phys Instr	2
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.234	Differential Equations	3
	Gen Ed Elect	3
		(5) 15

COLLEGE OF ARTS AND SCIENCES

Department of Physics and Applied Physics

Junior Year

Fall Semester

95.353	Elect - Magn I	3
96.393	Adv Exper Phys I	2
92.301	Applied Math I	3
	Gen Ed Elect	3
	Elective	3
		(5) 14

Spring Semester

95.310	Quantum Physics	3
95.338	Optics and Waves	3
95.354	Elect - Magn II	3
96.394	Adv Exper Phys II	2
92.302	Applied Math II	3
	Elective	3
		(11) 17

Senior Year

Fall Semester

95.411	Sen Phys Sem	1
95.413	Mechanics	3
95.421	Statistical Thermo	3
95.435	Quant Mech I	3
	Gen Ed Elect	3
		(10) 13

Spring Semester

95.436	Quant Mech II	3
95.452	Contemporary Physics	3
	Spec Elect	3
	Spec Elect	1
	Elective	3
		(6) 13

Total Program Requirement 120 credits

KERNEL = 47 physics credits, major field requirement = 60 credits, SPECIALIZATION = 13 credits (9 are specified)

* alternative introductory calculus-based physics courses may be substituted with departmental approval

() number of specified physics credits.

Physics - Primarily Lecture Courses (Course Prefix: 95)

95.101 Introductory Physics

A survey course for students majoring in sound recording technology. Topics covered include: one and two dimensional motion, Newton's Laws of dynamics, statics, circular motion, work and energy, linear and angular momentum, electrostatics, electric and potential fields, magnetic

fields, vibrations, waves, sound, Faraday's Law and AC circuits. Corequisite: 96.101. II(3,0)3

95.103 General Physics I

The first semester of a one-year course which surveys the field of physics at a non-calculus level. Topics include force and motion, vectors, gravity, energy and momentum, heat and thermodynamics, and oscillations, waves, and sound.

Although the course emphasizes conceptual understanding, a functional knowledge of algebra and geometry is essential. Corequisite: 96.103. I,II(3,0)3

95.104 General Physics II

A continuation of General Physics I. Topics include electricity and magnetism, geometrical and physical optics, modern physics, atoms, molecules, and nuclei. Prerequisite: 95.103. Corequisite: 96.104. II(3,0)3

95.112 Freshman Physics Seminar

An introduction to the scientific methods of physics and the exploration of research opportunities for undergraduates. II(1,0)1

95.121 Exploring the Universe

Topics covered will include: Planet earth, its structure, plate tectonics, greenhouse effect, ozone layer, craters and dinosaurs; out satellite - Moon; other planets; our star - Sun and its energy source; other stars, the HR diagram and stellar evolution, white dwarfs, neutron stars, supernovae, blackholes; our galaxy, the Milky Way, its structure; other galaxies; the universe, its structures and expansion; evolution of galaxies, quasars, cosmology, the Big Bang and unification of the forces of nature. I,II(3,0)3

95.141 Physics I

First semester of a two-semester sequence for science and engineering majors. Mechanics including vectors, kinematics in one and two dimensions, Newton's laws of dynamics, work and energy, energy conservation, linear momentum conservation, rotational kinematics and dynamics, Newton's Universal Law of Gravitation, oscillatory motion and mechanical waves. Corequisites: 92.131, 96.141. I,II(4,0)3

95.144 Physics II

Continuation of 95.141. Optics including reflection, refraction, interference, and diffraction. Electricity and magnetism including Coulomb's Law, electric field,

Gauss' Law, electric potential, Ohm's Law, DC circuits with resistors and capacitors, magnetic field, current loops, Ampere's Law, Faraday's Law, inductance, Maxwell's equations, and electromagnetic waves. Modern physics including photoelectric effect, hydrogen atom and the stability of the Bohr orbits, atomic spectrum of hydrogen, and deBroglie waves. Prerequisite: 95.141. Corequisites: 92.132, 96.144. I,II(4,0)3

95.161 Honors Physics I

Introductory mechanics at a more challenging level and the first semester of a sequence for physics majors. Mechanics of particles in one dimension, kinematics, forces, dynamics; particles in two and three dimensions, vectors, curvilinear and oscillatory motion; conservation principles, work, energy, linear momentum, collisions; rotational mechanics, angular momentum, torque and static equilibrium; gravitation and planetary orbits; wave motion, transverse and longitudinal, standing waves. Corequisite: 92.131, 96.161. I(4,0)4

95.164 Honors Physics II

Geometrical optics, reflection, refraction, flat and curved mirrors, thin lenses; physical optics, interference and diffraction; electrostatics, charge, electric forces, fields and flux, electric potential, capacitance and field energy; electric charge in motion, currents, DC and RC circuits; magnetic fields, forces on moving charges, magnetic field of an electric current, electromagnetic induction, inductance, changing currents, AC circuits; electromagnetic radiation; the limits of classical electromagnetic theory. Prerequisite: 95.161. Corequisites: 92.132, 96.164. II(4,0)4

95.191 Experimental Analysis for Physics Majors

A lecture series on measurement uncertainties and error analysis. I(1,0)1

95.201 Principles of Physics I

The first semester of a calculus-based one-year course for non-engineering majors which surveys the field of physics. Topics include motion, equilibrium, circular motion, work, energy, momentum, elasticity, vibrations, fluids and the laws of thermodynamics. Prerequisite: 92.132. Corequisite: 96.103. I(3,0)3

95.202 Principles of Physics II

A continuation of Principles of Physics I. Topics include electric fields, dc currents, magnetic fields, Faraday's law, waves, sound, geometrical and physical optics, optical instruments, relativity, quantum concepts, atoms and molecules, solid state physics, nuclear physics and radiation. Prerequisite: 95.201. Corequisite: 96.104. II(3,0)3

95.204 Introduction to Radiation Sciences

This course is designed to introduce students to the working practices encountered in health physics. This is accomplished through field trips to local facilities that use radioactive materials, laboratory exercises, and class discussions. This class exposes the student to basic health physics procedures, vocabulary, and equipment. II(3,0)3

95.210 Introductory Modern Physics

Special theory of relativity, kinetic theory, blackbody radiation, photoelectric effect, x-rays, Compton scattering, Bohr theory, Frank-Hertz experiment, Wilson-Sommerfeld, de Broglie waves, wave packets, duality, Heisenberg's uncertainty principle, Schroedinger's equation for square and step wells. Atomic physics including spherical harmonics, angular momentum, Zeeman effect, Paschen-Back effect and periodic system of elements. Prerequisite: 95.144 or 95.164. II(3,0)3

95.212 Sophomore Physics Seminar

Discussions on current topics in physics. II(1,0)1

95.245 Physical Properties of Matter

Fluid statics, dynamics of fluids, properties of solids, advanced topics in waves and vibrations, temperature and heat flow, kinetic theory of gases, thermodynamics, and the limits of classical physics. Prerequisites: 95.141 or 95.161, Corequisites: 92.132, 96.245 II(4,0)3

95.269 Honors Physics III

Statics and dynamics of fluids, pressure, viscosity, Archimedes and Bernoulli principles, properties of solids, stress and strain, shear, advanced topics in waves and vibrations, damping, resonance in mechanical and AC oscillators, thermodynamics, Maxwell's velocity distribution, blackbody radiation, and the limits of classical physics. Prerequisite: 95.141, Corequisites: 92.232, 96.245 I(4,0)4

95.310 Quantum Physics

Schroedinger's equation, one dimensional wells, simple harmonic oscillator, three-dimensional wells, hydrogen atom, electronic configuration, perturbation, helium atom, molecular structure and laser action. Prerequisite: 95.210. II(3,0)3

95.312 Junior Physics Seminar

Discussions on current topics in physics. II(1,0)1

95.337 Geometrical Optics

Properties of light, plane surfaces and prisms, thin and thick lenses, mirrors and stops, matrix methods applied to Gaussian (paraxial) optics, Lagrange-Helmholtz invariant, primary and chromatic aberrations, ray tracing and Abbe's sine condition, basic optical instruments including cameras, telescopes, and microscopes. Prerequisite: 95.245. I(3,0)3

95.338 Optics and Waves

Wave nature of light, mathematics of wave motion, electromagnetic theory of light propagation, reflection and refraction, Fresnel coefficients, polarization, interference, Young's experiment, fringe visibility and coherence, various interferometers, Newton's ring and applications, Fraunhofer diffraction by single and multiple apertures and diffraction gratings. Prerequisite: 95.245. II(3,0)3

95.353 Electromagnetism I

The theory of electromagnetic fields using vector analysis: electrostatic fields and potentials in vacuum, conductors, and dielectric media, magnetic effects of steady currents in nonmagnetic media, magnetic induction and time varying currents and fields. (offered as 95.553 for graduate credit) Prerequisites: 92.234, 95.210. I(3,0)3

95.354 Electromagnetism II

Magnetic materials, electric multipoles, solutions to Laplace's equation, boundary conditions, image charge problems, Maxwell's equations; propagation of electromagnetic waves in vacuum, conductors and dielectrics; reflection and refraction of electromagnetic waves; radiation from dipoles and antennas. (offered as 95.554 for graduate credit). Prerequisite: 95.353. II(3,0)3

95.355 Physics of Radiation and Nuclei

A survey of atomic and nuclear physics directed to an understanding of the basic modern physics used in radiological science and nuclear engineering. Material covered includes but is not necessarily limited to the following topics: classical and relativistic relationships for momentum and energy, mass energy relationships, motion of charged particles in electric and magnetic fields, mass and charge of the electron, atomic mass and isotopes, the photon, the photoelectric effect, the Compton effect, wave particle dualism and probability, absorption of photons, scattering and scattering cross sections, Rutherford's nuclear atom, atomic spectra and Bohr's theory of the hydrogen atom, emission and absorption spectra and the selection rules, DeBroglie hypothesis, neutron diffraction, the Schroedinger wave equation, the uncertainty principle, systematics and structure of the nucleus, nuclear forces and nuclear models. (offered as 98.555 for graduate credit) Prerequisite: 95.144. II(3,0)3

95.383 Astronomy and Astrophysics I

This course is designed for an interdisciplinary general undergraduate (upper-classmen) audience. Fundamentals of astronomy and astromechanics, introductory survey of astrophysics and the solar system (i.e. planetary astronomy). I(3,0)3

95.384 Astronomy and Astrophysics II

Continuation of 95.383. Sun as a star, stellar and galactic astronomy, and cosmology. II(3,0)3

95.401 Radiation Safety and Control I

Introduction to radiation protection, including radiation sources, radiation dose and dose measurement, radiation exposure, radiation protection techniques, monitoring methods and instruments, contamination control and waste storage, facility design, hazards analysis, and applied health physics techniques for the safe handling and control of radioactive material including laboratory. (offered as 98.501 for graduate credit) Prerequisite: 95.355. I(3,3)4

95.402 Radiation Safety and Control II

A laboratory course giving students experience with equipment and practices of current use in the radiation protection field, and extension of 98.401 giving some of the practical aspects of radiation safety and control. (offered as 98.502 for graduate credit) Prerequisite: 95.401. II(3,3)4

COLLEGE OF ARTS AND SCIENCES

Department of Physics and Applied Physics

95.411 Senior Physics Seminar

Discussions on the role of the professional physicist in society. I(1,0)1

95.413 Mechanics

Coordinate transformations and vectors; motion in one and three dimensions; oscillators: linear and non-linear and driven; non-inertial frames, central forces, collisions, planar motion of rigid bodies in two and three dimensions. Center of mass and moment of inertia, Lagrangians. (offered as 95.513 for graduate credit) Prerequisites: 92.301 and 95.144 or 95.164. I(3,0)3

95.421 Statistical Thermodynamics

An integrated study of the thermodynamics and statistical mechanics, review of the experimental foundations and historical development of classical thermodynamics; probability and statistical methods of studying macroscopic systems; atomic basis of the laws of thermodynamics and microscopic definitions of thermodynamics quantities using the method of ensembles; entropy and related quantities; TdS equations, Maxwell relations, equation of state, and applications: canonical and grand canonical ensembles; phase transitions; quantum statistics; application to radiation, magnetism, specific heats. (offered as 95.521 for graduate credit) Prerequisites: 92.301 and 95.310. I(3,0)3

95.422 Environmental Radiation and Nuclear Site Criteria

Study of sources, distribution, environmental transport and dose projections of environmental impact of nuclear fuel cycle. Offered as 98.522 for graduate credit. Prerequisite: introductory course covering basic nuclear concepts. II(3,0)3

95.435 Introductory Quantum Mechanics I

De Broglie waves, the Schrodinger equation, wave functions, wave packets, Heisenberg uncertainty principle, expectation values, particle in a box, the simple harmonic oscillator, free particles, step barrier, barrier penetration, square well potential, time independent perturbation theory. (offered as 95.535 for graduate credit) Prerequisite: 92.234 and 95.210. I(3,0)3

95.436 Introductory Quantum Mechanics II

The three dimensional Schrodinger equation, the deuteron nucleus, angular momentum, spin, the hydrogen atom,

spin-orbit interaction, Zeeman effect, Pauli exclusion principle, atomic structure, multi-electron atoms, the Fermi gas, X-rays. (offered as 95.536 for graduate credit) Prerequisite: 95.435. II(3,0)3

95.439 Electro-Optics with Lab

Optical properties of materials, including dispersion, absorption, Reflection and refraction at the boundary of two media. Crystal optics and induced birefringence and optical activity. Polarization states and Jones matrices. Applications to electro-optic devices. Experiments and projects involving the study of optical sources and detectors such as various types of lasers and interferometers. Thin film evaporation and measurement techniques. (offered as 95.539 for graduate credit) Prerequisites: 92.234, 95.338, 96.338. I(3,2)4

95.440 Image Processing

Basic physics of television and other imaging systems: representation and manipulation of images in digital form; Fourier analysis and filtering of images: detection of image features such as edges and regions; pattern recognition; three-dimensional visual perception in man and machine; examples of image processing tasks from such areas as medicine, industrial inspection and robotics; laboratory exercises with an image processing system utilizing and Octec 2000 image analyzer and a Data General Nova 4/C Computer. Ability to program a computer is required. (offered as 95.540 for graduate credit) Prerequisites: 92.234, 95.338. II(2,3)4

95.441 Radiochemistry

This course stresses analytical techniques applicable to identification and quantification of radionuclides in various sample types. Considerable time will be spent on review of general chemistry and inorganic analytical chemistry. The theories and applications of various separation techniques including precipitation, solvent extraction, ion exchange chromatography, and electrodeposition will be discussed with emphasis on separation of radioactive species. Additional material to be covered includes instrumental techniques for analysis of radioactive species, radiotracer and isotope dilution techniques, neutron activation analysis, and sample preparation. (3,0)3

95.447 Laser Physics and Applications

Spontaneous and stimulated emission line broadening processing, rate equations, laser oscillation condition, spectral output of lasers. Gaussian beam propagation and resonator design parameters. Key features of ultraviolet through far infrared laser systems. Application to spectroscopy, radar, welding. (offered as 95.547 for graduate credit) Prerequisite: 95.335. II(3,0)3

95.450 Optics Project

A project to be completed by either an individual or two students working as a team to design and test an optical system which will involve a synthesis of a substantial number of optics principals and technique. II(3,0)3

95.451 Fiber Optics

Introduction to optical communications; basic theory of light guiding; propagation characteristics and focusing effect of an optical waveguide; optical sources and detectors for fiber communications; fundamental parameters of optical fibers, fabrication and testing methods for optical fibers. Laboratory experiments will include optical fiber parameter measurements, sensors, connectors, sources and detectors. (offered as 95.551 for graduate credit) I(2,3)4

95.452 Contemporary Physics

Capstone course for physics majors. II(3,0)3

95.461 Nuclear Physics I

This course is designed to familiarize the student with a few research areas in the field of nuclear physics. The topics covered may vary from year to year. They will be chosen from the following list: nuclear constituents, fundamentals of interaction forces, liquid drop model and stability energetics, cross sections, passage of ionizing radiations through matter, alpha-decay, beta-decay and electron capture, gamma-decay and internal conversion, nuclear reaction systematics, fission and fusion, models of nuclear structure, and reaction mechanisms. (offered as 95.561 for graduate credit). Prerequisite: 95.336. I(3,0)3

95.462 Radiation Biology

Study of biological effects and mechanisms of action of ionizing radiations from sub-cellular through whole organism and ecological levels. (offered as 98.562 for graduate credit) Prerequisite: introductory nuclear course and course in human physiology. II(3,0)3

Department of Physics and Applied Physics

95.472 Solid State Physics

Crystal structures, x-ray diffraction, crystal binding, lattice vibrations, free electron and band models of metals. (offered as 95.572 for graduate credit). Prerequisites: 95.336 and 95.421. II(3,0)3

95.477 Solid State Electronic and Optoelectronic Devices

This course is an introduction to solid state electronic and optoelectronic devices for undergraduate science students (i.e. biology, chemistry, mechanical engineering, electrical engineering, physics, etc.) graduate students just entering a scientific endeavor which utilizes solid state devices, and practical engineers and scientists whose understanding of modern electronics and optoelectronics needs updating. The course is organized to bring students with a background in sophomore physics to a level of understanding which will allow them to read much of the current literature on new devices and applications. The course will cover fundamental crystal properties, atoms and electrons, energy bands and charge carriers, excess carriers, junctions and p-n junction diodes (includes photodiodes and light-emitting diodes). Three or four practical demonstrations will also be performed with the analysis of the generated data assigned as homework. (offered as 95.577 for graduate credit) I(3,0)3

95.478 Wave Guides and Diode Lasers

This course is a continuation of 95.477 and serves as an introduction to solid state electronic and optoelectronic devices. The course will cover bipolar junction transistors, field effect transistors, integrated circuits, lasers, switching devices, and negative conductance microwave devices. Three or four practical demonstrations will also be performed with the analysis of the generated data assigned as homework. (offered as 95.548 for graduate credit) II(3,0)3

95.481 Mathematical Methods of Radiological Sciences

An applied course emphasizing the mathematical skills used in radiological sciences/health physics fields, including special techniques used in radiation physics, radiation dosimetry, and radiation shielding. Computer applications will be emphasized. (offered as 98.581 for graduate credit) I(3,0)3

95.482 Numerical Methods of Radiological Sciences

Advanced mathematical treatment of topics covered in 98.481 with extensive application of computer techniques to problem solutions applicable to Radiological Sciences and Protection. (offered as 98.582 for graduate credit) Prerequisite: 95.481. II(1,6)3

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of instructor.

95.605, 606 Mathematical Methods of Physics I-II

Vector and Cartesian tensor analysis; matrices and determinants; partial differential equations, boundary value problems, and special functions. Numerical analysis and applications; theory of analytical functions; Green's functions. I(4,0)4; II(4,0)4

95.607 Lie Algebras in Particle Physics

Introduction to group theory and its application to high energy physics; definition of a group and its representations; Lie groups and Lie algebras; study of SU (2) Lie algebra, its representations and the Wigner-Eckart theorem; isospin group; roots, weights and simple roots of simple Lie algebras and applications to the SU (3) group; tensor methods for lie algebras; SU (3) flavor symmetry; Young Tableaux for decomposing products of representations; SU (N) group; SU (6) and the Quark Model; the color SU (3) group and the theory of strong interaction of quarks; hadron mass; splittings using group theory; grand unification and the SU (5) group. Prerequisite: 95.616. (3,0)3

95.608 Introduction to Particle Physics

Introduction to quark models; unified gauge theory of weak and e.m. interactions; weak decays of leptons and hadrons; quantum chromodynamics and strong interactions of quarks and gluons; asymptotic freedom; the bound states of quarkonia; the E1 and M1 transitions in quarkonia. Prerequisites: 95.607 and 95.617. (3,0)3

95.611 Classical Mechanics

Review of fundamental principles of mechanics. Central force motion and stability problems. Lagrangian formulation, including Hamilton's principle; Lagrange multipliers. Coupled harmonic oscillators, normal modes. Hamiltonian formulation: Hamilton's equations, finite and infinitesimal canonical transformations, Hamilton - Jacobi method, and canonical invariants. Prerequisite: 95.513. I(3,0)3

95.612 Mechanics of Continuous Media

Continuum mechanics: vibrations of strings; introduction to Lagrangians of continuous systems; introduction to fluid mechanics; sound waves; viscous fluids; surface waves on fluids; introduction to tensor analysis, elastic continua. Prerequisite: 95.513 or 95.611 or equivalent. II(3,0)3

95.615 Quantum Mechanics I

The representation of quantum states as abstract vectors. Superposition of states. Quantum operators and their matrix representations. Angular momentum operator as the generator of rotations. Eigenvalues and eigenstates of angular momentum. The uncertainty principle. Spin one-half and spin one as examples. Addition of angular momentum. The Hamiltonian operator and the Schrodinger equation. One dimensional examples. The momentum operator, eigenstates of position. Operator solution of the harmonic oscillator. I(3,0)3

95.616 Quantum Mechanics II

Quantum mechanics in three dimensions. translational and rotational invariance and conservation of linear and angular momentum, center-of-mass coordinates. Position-space representation of the angular momentum operator, orbital angular momentum eigenfunctions. Bound states of central potentials, including the Coulomb potential and the hydrogen atom. Approximation methods: time-independent perturbations, applications to the Stark effect, the Zeeman effect, spin-orbit coupling in hydrogen. The variational method. Time dependent perturbations. Indistinguishable particles: multielectron atoms, covalent bonding. Scattering. Electromagnetic interactions: emission and absorption of radiation. Prerequisite: 95.615 or permission of instructor. II(3,0)3

95.617 Advanced Quantum Mechanics I

Dirac equation as a single particle wave equation, free particle spinors and plane waves, matrices and relativistic covariance, nonrelativistic approximation and the fine-structure of the H atom. Quantization of the e.m. field in the coulomb gauge; interaction of an atom with the quantized radiation field; radiative transitions in atoms; Thomson scattering; classical and quantized Lagrangian field theory; symmetries and conservation laws: quantization of the real and complex Klein-Gordon field; Dirac Field and the covariant quantization of the e.m. field; Feynman propagators; the interaction picture and the S-matrix expansion in perturbation theory and the Wick's Rule. Feynman diagrams and rules for calculating S-matrix elements in QED; formulas for cross-section and spin and photon polarization sums; calculation of cross-sections for (1) $e^+e^- \rightarrow l^+l^-$ (2) $e^+e^- \rightarrow e^+e^-$ (3) Compton scattering and (4) scattering of electrons by an external e.m. field. Prerequisite: 95.616. I(3,0)3

95.618 Advanced Quantum Mechanics II

Radiative corrections to processes in quantum electrodynamics; mass and charge renormalization; dimensional regularization; vacuum polarization; anomalous magnetic moment of the electron and the Lamb-shift; unified gauge theory of electro-weak interactions; W and Z bosons and their properties; introduction to quantum chromodynamics. Prerequisite: 95.617. (3,0)3

95.631 Nonlinear Optics

Brief review of linear optics and optical waves in anisotropic linear media. Wave propagation in nonlinear media. Acousto-optics. Second order nonlinear optical phenomena: sum and difference frequency generation, parametric amplification, Pockels effect and electro-optic modulators based on them. Third order nonlinear optical phenomena: third harmonic generation, simulated Raman scattering stimulated Brillouin scattering, intensity dependent refractive index and Kerr effect. Magneto-optical phenomena and the physics of photo-refractive materials. I(3,0)3

95.632 Integrated Optics

Planar optical waveguide modes. Wave guide fabrication methods. Losses in optical wave guides. Input and output cou-

plers. Coupling between wave guides. Electro-optics and acousto-optic modulators. Semiconductor lasers and detectors. (3,0)3

95.657 Electromagnetic Theory I**95.658 Electromagnetic Theory II**

Electrostatics and magnetostatics with special attention to boundary value problems. Quasistatic fields and displacement currents. Maxwell's equations, special relativity, waveguides, scattering, radiation from accelerated charges; propagation in material media and plasmas, Kramers-Kronig relations. Prerequisite: 95.606. I(4,0)4; II(4,0)4

95.660 Quantum Mechanics of Many Particle Systems

Non-relativistic quantum mechanics of many-particle systems, having application to many-electron atoms, molecules, condensed matter and nuclei. Selection of topics varies and may include Hartree-Fock and Fermi-Thomas and their modern descendants: X-alpha, Green's Functions, Feynman graphs, density functionals; applications of group theory to symmetric clusters of atoms. Prerequisite: 95.616. (3,0)3

95.662 Nuclear Physics II

The nucleon-nucleon force; nuclear models; nuclear reaction theory and partial wave analysis of scattering; fast neutron physics. Prerequisite: 95.561. II(3,0)3

95.673 Advanced Theory of Solids I**95.674 Advanced Theory of Solids II**

Lattice vibrations and their interactions with X-rays, neutrons and light. The band model of solids and energy band calculations; the Fermi surface. Transport and optical properties in metals and semiconductors. Magnetism and magnetic resonance; superconductivity. Many-body theory and applications; collective excitations; Green's function techniques in solid state physics. Prerequisite: 95.616. I(3,0)3; II(3,0)3

95.675 Neutral Particle Transport I**95.676 Neutral Particle Transport II**

Boltzmann and integral transport equations. Spherical harmonic and variational methods. Corrections to diffusion theory. Special methods of solving transport equations. Adjoint functions. Applications. I(3,0)3; II(3,0)3

95.683 General Theory of Relativity I**95.684 General Theory of Relativity II**

Review of Newtonian gravitational theory and special relativity. Principles of equivalence. Tensor analysis in Riemann spaces. Einstein's field equations; tests of Einstein's theory. Spherically symmetric solutions. Applications in astrophysics and cosmology. I(3,0)3; II(3,0)3

95.686 Semiconductor Physics

Transport and optical properties of semiconductors. Statistics, collision mechanisms, effective mass theory, donors and acceptors. Hot electrons. High magnetic field phenomena. Devices: junctions and transistors. Gunn oscillators; semiconductor lasers. Prerequisite: 95.472. (3,0)3

Physics - Primarily Laboratory Courses (Course Prefix: 96)**96.101 Introductory Experimental Physics**

Experimental physics with topics correlated with the corequisite lecture course. Corequisite: 95.101 II(0,2)1

96.103 Experimental General Physics I

The first semester of a year course which surveys the field of experimental physics with topics correlated with the corequisite lecture courses. Corequisite: 95.103 or 95.201. I,II(0,2)1

96.104 Experimental General Physics II

A continuation of 96.103 with topics correlated with the corequisite lecture courses. Prerequisite: 96.103. Corequisite: 95.104 or 95.202. II(0,2)1

96.121 Exploring the Universe Laboratory

Laboratory exercises to illustrate the basic principles and measurement techniques of astronomy. Quantitative techniques, properties of angles, modeling the earth-sun system, comparative planetology, the constellations, the inverse square law, black-body radiation and spectra, the Hertzsprung-Russell diagram, distances to the stars, the Andromeda galaxy, cosmology. Corequisite: 95.121. I,II(0,2)1

96.141 Experimental Physics I

An introductory course on methods and techniques of experimentation in physics with experiments in mechanics selected to support the concepts of the corequisite lecture course. Corequisite: 95.141. I,II(0,2)1

96.144 Experimental Physics II

A continuation of 96.141 with experiments in optics, electricity and magnetism, and modern physics to support the concepts of the corequisite lecture course. Prerequisite: 96.141. Corequisite: 95.144. I,II(0,2)1

96.161 Honors Physics I Laboratory

An introductory laboratory course at the honors level on the methods and techniques of experimental physics. Lectures on measurement uncertainties and error analysis are included and experiments are selected principally in mechanics. Corequisite: 95.161. I(1,3)2

96.164 Honors Physics II Laboratory

A continuation of 96.161 with experiments selected principally in optics, electricity and magnetism. Prerequisite: 96.161. Corequisite: 95.164. II(0,4)2

96.201/96.301 Health Physics Internship I

Applied work experience as a health physics technician at a government laboratory or a radiation facility of some industry, hospital, or education and research institution. Prerequisites: radiological health physics major, 95.204, and approval of program coordinator. I(0,9)3

96.202/96.302 Health Physics Internship II

Applied work experience as a health physics technician at a government laboratory or a radiation facility of some industry, hospital, or education and research institution. Prerequisite: radiological health physics major, 95.204, and approval of program coordinator. II(0,9)3

96.245 Physical Properties of Matter Laboratory

Experiments are selected principally in properties of solids, vibrations, waves, heat, and thermodynamics. Prerequisite: 96.141. Corequisite: 95.245 II(0,2)1

96.260 Physical Instrumentation

Introduction to measuring devices emphasizing practical physical applications. Topics covered will include both analog and digital techniques, fundamentals of transistors, diodes, integrated circuits, operational amplifiers, filters, digital circuits, logic elements and the basics of a microprocessor. II(1,3)2

96.295 Intermediate Physics Laboratory

A course in experimental physics, with related theoretical material. Experiments are principally in the area of electrical measurements. Lectures are given on laboratory techniques and practices, and on the elementary theory of errors. Prerequisite: 95.144 or 95.164. I(1,3)2

96.306 Nuclear Instrumentation

Operating principles and applications of nuclear radiation detectors, associated electronic signal processing equipment, data analysis techniques. Topics covered include charged-particle, photon, and neutron detection, plus charged-particle and gamma-ray spectroscopy. Use of scintillators, photomultiplier tubes, solid state detectors, gas-filled counters, oscilloscopes, etc. (offered as 98.506 for graduate credit) Prerequisites: 95.355, 96.260. II(2,4)4

96.337 Geometrical Optics Laboratory

Experiments in geometrical optics covering the following topics; alignment techniques, reflection, thin and thick lenses, telescope, microscope, spherical mirrors, lens aberrations, radiometry and photometry. Prerequisites: 95.144 and 96.144 or 96.148. I(0,6)2

96.338 Physical Optics Laboratory

Experiments in physical optics covering the following topics; Michelson and Twyman-Green interferometers, Newton's rings, optical testing, multiple beam interference, diffraction grating, spectroscopy, Fresnel and Fraunhofer diffraction, reflection of light from a dielectric surface, polarization, holography. Prerequisite: 96.337. Corequisite: 95.338 or permission of the instructor. II(0,6)2

96.393 Advanced Experimental Physics I

Experiments in various branches of physics including optics and atomic physics. Prerequisite: 96.260. I(0,6)2

96.394 Advanced Experimental Physics II

A continuation of 96.393 with experiments selected mainly from condensed matter and nuclear physics. Opportunities for independent work by permission of the instructor. II(0,6)2

96.411/ 412 Senior Research in Radiological Sciences I/II

A research problem related to the field of radiation protection is investigated by the student under the direction of faculty and staff of the Nuclear Center. The student will present a seminar on this research project. Areas of research may include radiation shielding, radiation detection and measurement, radiation survey and monitoring, radiation biology, radiation chemistry, radiobiology, radiochemistry, radioecology, natural radioactivity, fallout, analyses and measurement of radioactivity and radiation levels associated with the operation of reactors and accelerators, and radioactive aerosols. Prerequisites: senior status as a major in the radiological health physics option and approved proposal. I,II(0,9)3

96.443 Radiochemistry Laboratory

This laboratory course will require the completion of between four and six separate laboratory procedures and participation in two to four demonstration sessions. Laboratories will stress various analytical techniques for determination of specific radionuclides. At least two laboratory sessions, which may extend more than one period, will deal with analysis of environmental samples of specific radionuclides. A variety of separation procedures including precipitation, solvent extraction, ion exchange chromatography, gas deemanation, and electro-deposition will be employed. (0,3)1

96.447 Experimental Laser Optics

Experiments investigate the characteristics of laser beams (mode structure, linewidth, coherence properties, beam divergence, etc.). A variety of CW and pulsed lasers in the UV, visible and the near IR will be used. Demonstration experiments include Q-switching, harmonic generation and stimulated Raman frequency shifting of lasers. Additional instrumentation such as a box-car averager and lockin amplifier will also be used for some measurements. (offered as 96.547 for graduate credit). Prerequisite: permission of instructor. II(0,6)2

96.451 Special Topics in Radiological Sciences I

This course is used to provide students with current information on a variety of current topics. Topics covered are announced prior to registration. Topics may vary from year to year. (offered as

COLLEGE OF ARTS AND SCIENCES*Department of Physics and Applied Physics*

98.551 for graduate credit) Prerequisite: senior status as a major in the radiological health physics option. I(3,0)3

96.452 Special Topics in Radiological Sciences II

This course is used to provide students with current information on a variety of current topics. Topics covered are announced prior to registration. Topics may vary from year to year. (offered as 98.552 for graduate credit) Prerequisite: senior status as a major in the radiological health physics option. II(3,0)3

96.495 Special Research Problems I

Special problems in physics assigned to the individual student with emphasis on modern research methods and preparation of results for publication. Prerequisite: permission of department chairperson and instructor. I(0,9)3

96.496 Special Research Problems II

A continuation of 96.495 for a second semester. Prerequisite: permission of department chairperson and instructor. II(0,9)3

96.497 Undergraduate Thesis I

Research in experimental and/or theoretical physics. Progress report required. Prerequisite: permission of department chairperson and thesis supervisor. I(0,9)3

96.498 Undergraduate Thesis II

A continuation of 96.497. A written thesis and seminar are required. Prerequisite: permission of department chairperson and thesis supervisor. II(0,9)3

**Courses for Non-Majors
(Course Prefix: 99)****99.101 Radiation and Life**

This course will provide students with an understanding of the nature, sources, uses, and biological effects of natural and man-made radiations. Radiations discussed include non-ionizing radiations such as ultra violet and microwave as well as the ionizing radiations produced by radon in homes and radionuclides released from nuclear power plants. Students will have a better understanding of the risks and benefits of radiation in the modern world. I,II(3,0)3

99.102 Radiation and Life Laboratory

This laboratory course which is suitable for non-science majors will provide the student with an opportunity for some hands-on experience with modern equipment used to identify and quantify levels of radioactivity in the environment. Students will measure radiation from a variety of sources and will determine concentrations of radionuclides in several environmental samples including making measurements of the radon levels in the air of their own homes. Students will also study the effects of ionizing radiation on the germination and growth rate of exposed seeds. Corequisite: 99.101. I,II(0,3)1

**Radiological Sciences -
Primarily for Graduate
Students**

Graduate courses are open to undergraduates with permission of instructor.

**98.611 Preparation for Health Physics
Certification**

Students have intensive review of problems from historical certification examinations and review of current federal regulations related to applied health physics. Prerequisite: 98.501. (3,0)3

98.514 External Radiation Dosimetry

Radiation quantities and units; beta, gamma and neutron dosimetry; principles of charge measurement and energy transfer; use and calibration of instruments; calibration sources; accident dosimetry; standards and regulations. Prerequisite: 95.401/402. (3,3)4

98.516 Internal Radiation Dosimetry

Physiological models for reference man; metabolic models and kinetics; ICRP publications; bioassay models; accident internal radiation dosimetry; standards and regulatory requirements. (3,0)3

98.646 Accelerator Health Physics

Health physics problems common to particle accelerator facilities are presented with discussions of current approaches to their solutions. Estimation of the levels of induced radioactivity expected and calculations of shielding and ventilation requirements will be made for a variety of particle accelerators. Prerequisites: 95.401,402. (3,0)3

98.666 Reactor Health Physics

Health physics problems associated with nuclear reactor facilities with emphasis on commercial nuclear power including the radiation protection program elements needed for the control of external and internal radiation sources for the safe and efficient operations of these facilities. Prerequisites: 95.401,402.

98.596 Medical Physics

A discussion of the methods and procedures involving the use of radiation and radioactive materials in medical diagnosis and therapy, including medical radiation dosimetry and computer applications. (3,0)3

*Department of Political Science***Department of Political Science**

William Lindeke, Chairperson

Professors: Frederick Lewis, William Lindeke, Hai Ba Pho

Associate Professors: Joyce Denning (Emerita), A. 'Nick' Minton

Assistant Professors: Susan Gallagher, Jeffrey Gerson

Affiliated Faculty: Dean Bergeron, John Wooding

The Political Science Department offers a major leading to the Bachelor of Arts degree and also a minor program of study.

Political Science Major

The Political Science Department's commitment to excellence in undergraduate teaching has yielded an enviable number of graduates successful in law, government, education communications and business.

The major in Political Science is designed to provide a knowledge of the nature of politics and government on the local, state, national, and international levels and of the functions and theories of the state. The courses enable the student to develop an understanding of the political process and an ability to analyze political systems, relationships, and problems. The major affords excellent preparation for graduate education, law school, public administration, public service, social science teaching and, most importantly, intelligent citizenship.

The Department of Political Science provides a full complement of core courses, including introductions to research methods and to the discipline itself. The department offers practica, computer modeling opportunities, and encourages participation in Model International Organization programs. It sponsors internships and individualized research opportunities for its students.

The introductory courses for majors strengthen the freshmen experience and create common bonds among students in Political Science. Core offerings on American Politics and Policy have been augmented by others on comparative politics of countries ranging from Eastern Europe to Southeast Asia to Southern Africa.

The department also offers specialized courses related to gender and citizenship, political economy, race and ethnicity, and public policy of interest to students in a variety of majors across the university.

In addition to traditional courses in political thought, recent course offerings have included work in state theory, feminist political theory, current theoretical conflicts in constitutional interpretation, and the politics of arts and culture.

Overall credit hour requirement: A major in Political Science consists of 36 credits (i.e., a three-credit Practicum and 33 other credits) to a maximum of 45 credits. At least 15 credits must be taken at the 300 course level or above.

Specific course requirements:

1. 46.101 Intro to American Politics

Normally taken fall semester of the freshman year; a "majors only" section facilitates department cohesion for entering freshmen and helps them not to feel "lost";

2. 46.201 Intro to Political Analysis

Meets the human values requirement of the University core curriculum for political science majors. It is normally taken spring semester of the freshman year and may be waived for upper division transfer students. This course surveys the scope and methods of political science;

3. 46.301 Research Methods in Political Science

Normally taken spring semester of the junior year as a prelude to writing a senior thesis which is done in 46.401;

4. 46.401 Research Seminar in Political Science

Requires writing a substantial thesis paper and is normally taken fall semester of the senior year, after completion of 46.301; and

5. One three-credit practicum course which will be graded "satisfactory" or "unsatisfactory." Take either 44.496 Practicum experience or 44.497 Practicum in the Law, or another practicum, if offered. The practicum involves 75-100 hours of practical experience in politics, law, government etc. Students may not take more than one practicum as part of the minimum

120 credits required for graduation without prior Department approval.

Distribution requirement: the Department also requires at least one course in addition to any specifically required courses in four of the following five areas: 1) American Politics and Law, 2) Comparative Politics, 3) Political Thought and Theory, 4) International Relations and Organizations, and 5) Public Policy and Administration.

Focus requirement: In conjunction with the faculty advisor, political science majors are expected to formulate a program of study in the major that includes three to five courses that focus in a progressively more advanced manner upon one political science sub-area to assure a depth of knowledge. Sub-areas may be defined flexibly.

Waiver of any requirement may be granted only by the Department Chair in unusual circumstances and for very good reasons.

The Department recommends that Political Science majors select supporting coursework from history, sociology and economics, and encourages students to develop minor areas of study or supporting majors in related social science disciplines.

Students transferring to the college and wishing to major in Political Science must make individual arrangements with their faculty advisor or the Department Chairperson regarding satisfaction of major course requirements.

Career Opportunities

Many Political Science majors pursue careers in public affairs on the staffs of elected officials, government agencies, public interest groups, or corporate public affairs departments. Journalism, broadcasting, public relations and other communications-related professions have also been of interest to majors. The major also provides good training and skills for other business applications.

As part of the required Practicum, over the years, student majors have pursued internships involving all of these areas. The Department of Political Science currently helps administer a paid summer internship in a Congressional office and it receives and posts notices of many other significant internship opportunities in governmental and non-governmental settings.

Because many Political Science majors are

COLLEGE OF ARTS AND SCIENCES

Department of Political Science

interested in pursuing careers in the legal field, the Department offers several course opportunities in the legal-political area. In appropriate instances, this may include a practicum course that provides exposure to legal practice. Political Science majors may also elect the interdisciplinary legal studies minor; however, political science courses utilized for the minor may not also be credited to the major, and the number of political science courses taken for the major and minor together may not exceed 45 credits within the minimum

120 credits required for graduation.

Minor Requirements

Political Science

Political Science as a minor area of study consists of 18-24 credits of coursework. At least six credits must be taken in coursework at the 300 level or above.

Coursework is selected by the student in consultation with his advisor. Students who desire to make the most effective use of a minor in Political science in pursuing specific career objectives in occupational areas such as law, foreign service, business, management, and public service should consult with the political science faculty in choosing courses which are most appropriate as preparation for such career objectives.

General Requirements

For students entering the University in Fall 1993 and subsequently

A major in political science consists of 36 credits (i.e. three credit Practicum and 33 other credits) to a maximum of 45 credits. At least 15 credits must be taken at the 300 level or above.

Freshman Year

Fall Semester

42.101	College Writing I (Gen Ed)	3
92.	Mathematics* (Gen Ed)	3
46.101	Intro to American Politics	3
	Beh & Soc St (Gen Ed)	3
	Beginning Language I	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science* (Gen Ed)	3
46.201	Political Analysis**	3
	Beginning Language II	3
46.	Distribution Requirement***	3
		15

Sophomore Year

Fall Semester

46.	Distribution Requirement***	3
	Beh & Soc St (Gen Ed)	3
	Science* (Gen Ed)	3
	Intermediate Language I	3
	Historical Studies (Gen Ed)	3
		15

Spring Semester

46.	Distribution Req.***	3
	Literature (Gen Ed)	3
46.	Focus Requirement****	3
	Intermediate Language II	3
	Free Elective	3
		15

Junior Year

Fall Semester

46.	Distribution Requirement***	3
46.	Focus Requirement****	3
	Aesthetics (Gen Ed)	3
	Science* (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

46.	Distribution Req***	3
46.	Focus Requirement****	3
46.301	Res Methods in Poli Sci	3
	Free Elective	3
	Free Elective	3
		15

Senior Year

Fall Semester

46.401	Research Seminar in Politics	3
46.	Distribution or Free Elective***	3
46.	Focus Requirement****	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

46.496	Practicum Experience or	
46.497	Practicum of the Law	3
	Focus or Free Elective****	3

Free Elective	3
Free Elective	3
Free Elective	3
	15

*Consult the Academic Policy section of this catalogue regarding the General Education requirements for mathematics and sciences.

**The Values, Concepts and Choice requirement is met for majors by taking Political Analysis (46.201).

***Distribution Requirements: The department also requires at least one course in four of the following five sub-areas:

American Politics and Law
Comparative Politics
Political Thought & Theory
Public Policy & Administration
International Relations & Organizations

****Focus Requirements: In conjunction with the faculty advisor, political science majors are expected to formulate a program of study in the major that includes three to five courses that focus in a progressively more advanced manner upon one political science sub-area to assure a depth of knowledge.

Waivers of any requirement may be granted only by the department chair in unusual circumstances and for a very good reason.

The Department recommends that political science majors select supporting coursework from economics, history, and sociology and encourages students to develop minor areas of study or supporting majors in related social science disciplines.

Political Science Courses (Prefix: 46)

46.101 Intro to American Politics

An introduction to the politics, structure and behavior of the American National Political Community. 3 cr

46.110 Intro to Politics

An introductory exploration of basic political concepts, ideologies, and themes. Stresses the importance of understanding politics for everyday life. 3 cr

46.112 Intro to Comparative Political Systems

A cross-cultural analysis of various governmental systems; elements common to all forms of government are emphasized and variations among contemporary political systems are discussed. Balance between developed and Third World countries. 3 cr

46.121 Intro to International Relations

Introductory survey of recent methods and approaches used in the study of international politics; focus on current foreign policy problems of the major world powers. 3 cr

46.201 Intro to Political Analysis

Introduces the Political Science major to the scope of politics as a discipline. Highlights value questions through analysis of the political, socio-demographic and constitutional background of selected contemporary public issues and policies. 3 cr

46.205 Intro to Political Economy

The artificial boundaries between political and economic analysis are transcended as current problems in political economy are surveyed, examined and analyzed. 3 cr

46.215 Intro to Public Policy

The relationship between the political process and contemporary public policy issues, particularly those involving scientific and technological concerns, is examined through selected case studies and other readings. 3 cr

46.220 Intro to Gender and Politics

An introduction to the way ideas about gender have shaped politics and government. 3 cr

46.230 Intro to Law & the Legal System

An introduction to the nature of the legal process and the operation of the American legal system; consideration of its political and social functions. 3 cr

46.231 Intro to Political Thought

A critical survey of the history of Western political thought. 3 cr

46.235 Intro to American Constitutional Government

An introductory study of American Constitutional Law and Politics; analysis of constitutional doctrine and the American

constitutional system, with emphasis on contemporary controversies. 3 cr

46.265 Intro to American State and Local Government

Examination and study of politics and government at the state and local levels, with emphasis on Massachusetts. 3 cr

46.301 Research Methods in Political Science

Designed to equip the major with a comprehensive, basic repertoire of practical and academic research skills to be applied to writing research seminar theses and to various post-graduate activities. 3 cr

46.307 American Political Thought

A survey of the historical development of American political thought from the colonial era to the present. 3 cr

46.309 Political Socialization

An in-depth examination of the acquisition of political attitudes and values within the American political system. 3 cr

46.310 Contemporary Political Theory

Examination of major ideological currents in the contemporary world. Topics include communism, fascism, anarchism, socialism, nationalism, liberalism and utilitarianism. 3 cr

46.311 Political Obligation

Analysis of selected classical and modern theories of obligation including consensus, organic, prescriptive, and utilitarian models. Also examined are related problems and topics such as legitimacy, authority, justice, freedom, order, change, violence and civil disobedience. The similarities and differences among political, legal and moral obligations are considered. 3 cr

46.315 Politics of Arts and Culture

An analysis of political and theoretical perspectives in arts and culture. 3 cr

46.316 Politics and Film

An analysis of political ideas, movements and institutions through the use of American and International films. Examines film as art and commodity; as reflection or creator of political culture. 3 cr

46.320 Feminist Political Theory

An analysis of the theoretical perspectives of contemporary feminism. 3 cr

46.335 State, Bureaucracy and Policy

Analyzes theoretical perspectives on the State, bureaucracy and policy-making. Examines dominant theories of the State and applies them to practical policy questions. 3 cr

46.338 Political Participation

Political movements; voting and elections, parties and interest groups; civil disobedience in American politics. Consideration of causes, fluctuations and trends. 3 cr

46.340 American Politics

American Politics in an Era of Transition. An advanced study of interpretations of conflicts, problems and challenges in the American Political Culture, Political Economy, and Society at a time of change. The resulting political cleavages and coalitions; manipulation of symbols in elections; leadership techniques and opportunities; the capabilities of government, politics and bureaucracy. 3 cr

46.343 The Congress

Legislative Politics. An advanced study of representation, campaigns and elections, and the functioning of the American national congress within the American political system. 3 cr

46.344 The American Presidency

An examination of the nature of the American presidency and its functioning within the American political system. Specific attention is given to the problems and evolution of the presidency since World War I. 3 cr

46.345 Constitutional Law and Politics

An advanced study of American constitutional doctrine as it has developed historically through the process of constitutional adjudication. 3 cr

46.347 Civil Liberties and Civil Rights

Civil Liberties Law and Politics. The meaning of liberty and equality in America is sought through an examination of the development and nationalization of American concepts of civil liberty and equal rights. 3 cr

46.349 Politics of Race and Ethnicity

A study of the politics of race and ethnicity, focusing primarily on American society, and the racial and ethnic groups of the region. 3 cr

COLLEGE OF ARTS AND SCIENCES*Department of Political Science***46.350 Urban Politics and Policy**

A study of political power in, and the political structures of urban areas and the major issues and conflicts currently confronting them. 3 cr

46.352 Science, Technology and Public Policy

An advanced examination of selected scientific and technological policy issues; consideration of the relationship between government policy and technological development. 3 cr

46.353 Public Administration and Public Policy

An examination of the little studied fourth branch of government. Bureaucratic power in the American political system is reconsidered. 3 cr

46.357 Environmental Policy

American environmental values and politics; attitudes and behavior towards the environment. Special attention to current issues. 3 cr

46.360 European Politics: Tradition and Modernity

An analytical examination of selected modern European political systems, emphasizing similarities and differences in political culture, behavior, institutions, and performance. 3 cr

46.361 Southeast Asian Politics

A study of Southeast Asian countries, their anti-colonial struggles and their patterns of political development. Attention is also given to the recent struggle among the former Indochinese states and the broader international involvement in the region. 3 cr

46.363 Politics of China

A study of the recent development of governmental institutions, parties, and ideology in China. Emphasis is placed on the processes of nation-building in the post World War II period. 3 cr

46.366 Politics of Russia and the Former Soviet Union

Conflict and Change in the former Soviet Union. An examination of the relationship of politics to the functioning of post-Soviet societies. The influence of politics on economy, education, family life, religion, etc. 3 cr

46.367 Europe: The Tensions of Postmodern Politics

A comparative examination of the politics of several smaller European countries whose governments have attempted to incorporate significant social democratic aspects into their societies. Countries considered include: Sweden, Spain, Hungary, Czech Republic, and Italy. 3 cr

46.368 Middle Eastern Politics

An appreciation of Middle Eastern attitudes and values is utilized in developing insight into the tensions that exist within the Middle East and between the Middle East and the Western world. 3 cr

46.369 British Politics

An examination of the history and development of British politics. Focuses on the post-1945 era. 3 cr

46.371 Caribbean Politics

A comparative study of the political, social, cultural and economic forces that have led to the current situations in the countries of the Caribbean area (Mexico, Central America and the islands). 3 cr

46.373 Politics of Southern Africa

An examination of the changing politics of the twelve countries of Southern Africa. Topics include colonialism, revolution, democracy, apartheid, and development among the Southern African Development Community states. 3 cr

46.374 Democracy and Development

Explores the theories and experiences of countries newly converting to democracy in Asia, Africa, Latin America and the former Eastern Bloc. Also examines the strategies and prospects for development among the same countries. 3 cr

46.375 Politics of Japan and the Pacific Rim

An examination of the politics, policies and institutions of Japan, the "four tigers", and other countries of the Pacific rim area. 3 cr

46.378 International Political Economy

An examination of the politics of global economic relations stressing the role of international institutions, multinational corporations and other international actors on the policies of the nation-state. 3 cr

46.380 American Foreign Policy

A study of the processes of American foreign policy in the contemporary world. 3 cr

46.382 The Vietnam War

A study of U.S. foreign policy in Indochina and the international developments resulting in U.S. involvement in Indochina after World War II. Emphasis placed on the U.S. role in the 2nd Indochina War and the intensive domestic and international repercussions. 3 cr

46.383 Southeast Asians in the USA

A study of US refugee policy and the experience of recent immigrants from Southeast Asia. 3 cr

46.385 Computer-Assisted Study on Diplomacy

An in-depth case study of international conference and treaties including current diplomatic negotiations of international conflicts. Computers and Internet teleconferencing are extensively used by students organized in country-teams to simulate experiential diplomatic disputes and negotiations. 3 cr

46.390 Defense and Disarmament

An advanced study of the international security policies currently pursued by the United States, its allies and its adversaries; evaluation and analysis of the criticism of these policies and of the possibilities of achieving disarmament. 3 cr

46.397 Politics and Law of Labor

Consideration of a variety of political, legal and social issues involving labor relations, unions, employment, and dispute resolution, and their place in American society. 3 cr

46.398 Political Leadership

A study of the political leader as entrepreneur in several different settings. 3 cr

46.399 Judicial Review

An advanced examination of the contemporary controversy over judicial activism. 3 cr

46.401 Research Seminar in Politics

Original investigation in primary sources and secondary literature culminating in the writing of a major paper based on systematic research and methodological techniques. Prerequisite: 46.301 Required course for senior Political Science majors AKA: Senior Thesis. Can be taken for "Honors" credit if additional requirements are met 3 cr

*Department of Political Science***Reading Seminars
(46.402 through 46.450)**

Advanced and intensive reading, discussion, analysis, and research in selected areas of political study. Those listed here have been regularly presented. Others may be offered on an occasional basis.

46.404 Reading Seminar in Post-Soviet Politics

Extensive and advanced readings on post-Soviet systems. 3 cr

46.410 Reading Seminar and Instructional Internship in American Politics

Advanced reading and critical analysis in American Politics. Students selected will serve as group project leaders and tutors in association with a large introductory American politics course section. 3 cr

46.415 Reading Seminar and Computer Simulation in Int'l. Studies

Extensive and advanced readings and participation in an intercollegiate computer simulation exercise. 3 cr

46.420 Reading Seminar and Simulation Experience in International Organization

Students take part in a simulation of the proceedings of a regional or international organization, e.g., U.N., O.A.S., O.A.U., or the Arab League. They study all aspects of the selected institution but concentrate on key economic, social and security issues discussed in the body's debates. The course aims to give the student a clearer understanding of the forces and constraints which shape the foreign policies of individual states. 3 cr

Directed Studies

Directed study courses are available only to Political Science majors and may be elected provided that 1) the material to be covered is not available in any course to be offered in the semester which the directed study is taken, 2) an instructor is willing to undertake the directed study course, and 3) no more than nine credits in the major field are earned in directed study courses.

46.491 Directed Study in Political Science

Directed study offers the opportunity to engage in an independent study or research project under the supervision of a department member. Working closely with the instructor, students define and investigate a research problem in an area of special interest and present the results of their investigation in a significant paper. Prerequisites: permission of instructor and Chairperson. 3 cr

46.492 Directed Study in International Organizations

Advanced and intensive reading and other activity in connection with the study of selected international organizations. 3 cr

46.493 Directed Study in American Politics

Advanced and intensive reading and other activity in connection with the study of American politics and institutions. 3 cr

46.495 Advanced Tutorial in Politics

A program of directed study in which the advanced student develops an evaluative and critical essay. The purpose is to sharpen and refine techniques for scholarly research and presentation. This course may not be offered in place of the required seminar course. Prerequisite: demonstrated proficiency in an area selected for directed study and permission of the political science faculty and Chairperson. 3 cr

Practicum

One of the following courses is required of all Political Science majors:

46.496 Practicum Experience

A program of study and research for political science majors only stressing involvement in and first-hand knowledge and observation of the political life and relationships of national, state and local institutions. The purpose is to acquaint the student in a directed way with political institutions and political behavior. Specific requirements vary depending upon the nature of the program undertaken by the student. The course will be graded "S" (satisfactory) or "U" (unsatisfactory). 3 cr

46.497 Practicum in the Law

A program of study and research which includes involvement in and first-hand knowledge and observation of the legal system and legal practice. Open only to political science majors and, with certain restrictions, legal studies minors. The course will be graded "S" (satisfactory) or "U" (unsatisfactory). 3 cr

Department of Psychology

Charlotte Mandell, Chairperson

Professors: Janet Burke, Jon Hellstedt, Kathleen Hulbert, Robert Kunzendorf, Charlotte Mandell, Anne Mulvey, Ronald Pickett, Mary Roth Walsh

Associate Professors: William Berkowitz, Meg Bond, Joan Cannon, David Landrigan, Allyssa McCabe, Charles Nikitopoulos, Gloria Seeman, Richard Siegel, Joseph Waterman

Affiliated Faculty: Linda Silka

The Psychology Department is one of the largest and most active departments in the College and is an especially popular program for those interested in the social sciences. The faculty represent a blend of clinical, developmental, community, and experimental orientations. There is a substantial interest in questions of diversity and in feminist approaches to psychology.

The Department offers a major which leads to the Bachelor of Arts degree and also offers a minor area of studies.

Psychology Major

The Psychology major augments the general liberal arts education and provides the basis for graduate training and careers in mental health, education, research and industry. The Psychology curriculum acquaints students with scientific methods and studies and with theoretical foundations in the subfields of psychology (experimental, developmental, social, personality, clinical). It also emphasizes the applications of psychological knowledge and skills in many areas of human functioning. Students are encouraged to become involved in University and community programs and in supervised independent research. Each year the Department offers special awards to graduating seniors who have made outstanding achievements in these activities.

The major in Psychology consists of at least 30 credits in psychology (in addition to statistics) and no more than 45 credits (with at least 15 credits at the 300 course level or above) and must include the following courses:

1. Each of the following courses:
47.101 General Psychology
47.260 Human Development I

- 47.269 Research Methods
47.369 Statistics in Psychology
or
92.283 Statistics for the Behavioral Sciences (may be taken to fulfill this requirement and may be counted as a Math course for a second major, minor, core or general elective requirement, as well)

2. One course in each of the following three areas:

a. *Personality and Abnormal Psychology*

- 47.232 Psychology of Personality
47.272 Abnormal Psychology

b. *Social and Community Psychology*

- 47.209 Social Psychology
47.255 Community Psychology

c. *Experimental Psychology*

- 47.276 Theories of Learning
47.277 Sensation and Perception
47.278 Cognitive Psychology
47.373 Brain, Mind & Behavior (formerly, Biology of Behavior)

3. One Research Laboratory course.

- 47.375 Research Lab in General Experimental Psychology
47.381 Research Lab in Human Factors Engineering

4. One Advanced Seminar

- 47.473 Seminar: Social Psychology
47.474 Seminar: Developmental Psychology
47.475 Seminar: Clinical Psychology
47.476 Seminar: Experimental Psychology
47.477 Seminar: Contemporary Trends in Psychology

5. One 400-level or above psychology elective

(Seminar, Practicum, Directed Study, Tutorial, Graduate level course)

6. The remaining two to six courses of the major may be elected from any of the course offerings in psychology, with at least 15 credits of the 33-45 required in the major must be at the 300 level or above. Human Sexuality, 83.351 or 47.351, may be counted towards this requirement.

Students transferring to the college and wishing to major in Psychology must make individual arrangements with the

chairperson of the department regarding satisfaction of major requirements. In addition, students wishing to change their major from another college or department at UMass Lowell must have a minimum of 2.200 cumulative average.

Minor Requirements

A minor in Psychology consists of 18-24 credits of coursework. At least six credits must be taken in coursework at the 300 level or above in fulfilling the requirements for this minor area. Human Sexuality, 82.351, may count as part of minor area requirements.

Master of Arts in Community and Social Psychology

The Department also offers a Master of Arts degree in Community and Social Psychology. For information regarding the objectives and requirements of this graduate program, consult the "Graduate School Catalogue." A five year B.A./M.A. program is available to qualified students. Information regarding this program is available from the coordinator of the Graduate Program.

Sample Course of Study for Psychology

For students entering the University in Fall 1993 and subsequently

Freshman Year

Fall Semester

42.101	College Writing I (Gen Ed)	3
92.110	College Algebra* (Gen Ed) or Free Elective	3
47.101	General Psychology	3
	Beh & Soc St (Gen Ed)	3
	Beginning Language I	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science* (Gen Ed)	3
	Historical Studies (Gen Ed)	3
47.260	Human Development I**	3
	Beginning Language II	3
		15

Department of Psychology

Sophomore Year

Fall Semester

47.269	Research Methods	3
47.2	Personality/Abnormal Elective	3
	Literature (Gen Ed)	3
	Science* (Gen Ed)	3
	Intermediate Language I	3
		15

Spring Semester

47.2	Soc/Comm Psych Elec	3
47.2	Experimental Psych Elec	3
	Aesthetics (Gen Ed)	3
	Science* (Gen Ed)	3
	Intermediate Language II	3
		15

Junior Year

Fall Semester

92.283	Stats for the Beh Sciences	3
	Beh & Soc St (Gen Ed)	3
	Psych or Free Elective	3
	Values, C & C (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

47.3	Research Lab Elective	3
300/400	Psych Elective	3
	Psych or Free Elective	3
	Free Elective	3
	Free Elective	3
		15

Senior Year

Fall Semester

47.4	Advanced Seminar	3
300/400	Psych or Free Elective	3
300/400	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

47.4	Advanced Seminar	3
	Psych or Free Elective	3
300/400	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

**Please note that the requirement of 47.260 Human Development I does not apply to students who have previously taken 47.1163 Human Life Span, 47.261 Child Psych., 47.262 Adolescent Psych., or 47.264 Maturity and Aging.

Psychology Courses
(Prefix: 47)

47.101 General Psychology

Intended as an introductory course both for non-concentrators and for concentrators; this course surveys the major areas of psychology: the nature of psychology as a science, principles of learning, the relationship between physiological and psychological processes in humans and animals, sensation and perception, cognitive processes, motivation and emotion, personality and development, adjustment and behavior disorders, and social behavior. 3 cr

47.209 Social Psychology

An introduction to the study of social behavior in interpersonal relationships, groups, organizations, and the community. Topics include attitudes and attitude change, group dynamics, interpersonal influence, and non-verbal communication. 3 cr

47.232 Psychology of Personality

An introduction to the study of human personality including such topics as self-concept, anxiety and adjustment, achievement motivation. Psychoanalytic, humanistic, cognitive, and behavioral theories of personality are stressed with consideration of the interplay between theory and research. 3 cr

47.255 Community Psychology

A survey of the nature and practice of community psychology including principles of community organization and change, as seen in such areas as education, mental health, corrections, and social services. Students participate in field research or practice under the direction of an assigned agency, and classroom work includes discussion of the field experiences of the participants. 3 cr

47.260 Human Development I

Begins with an overview of major theoretical perspectives, research methods, and ethical issues in life-span human development. Based on a chronological approach,

it covers prenatal development and birth, infancy, childhood, adolescence, and the transition to adulthood. 3 cr

47.269 Research Methods

An integrated approach to methods of scientific research in psychology including research design and the use of statistics, the interpretation of data, and the role of the scientific method in psychology. Open to Psychology majors only. 3 cr

47.272 Abnormal Psychology

An introduction to the study of various patterns of mental, behavioral, and personality disorder with consideration of issues of diagnosis, etiology, and treatment in terms of contemporary theory, research, and practice. Prerequisite: 47.101 3 cr

47.276 Theories of Learning

Traces the development of theories of learning from earlier global theories to more recent and more specific ones. Behavioral, cognitive and physiological approaches are compared. Current issues of importance in the study of learning are stressed. Prerequisite: 47.101 3 cr

47.277 Sensation and Perception

Focuses on human sensory and perceptual capacities, and how people know the objects and events of the world through hearing, seeing, smelling, tasting, moving, and touching. In this course, students examine the bases of experiences which correspond to independent measures of the world and the nature of illusory experiences. Prerequisite: 47.101 3 cr

47.278 Cognitive Psychology

Examines the psychological bases of verbal and visual reasoning, logical and creative thought-processes, and linguistic and conceptual behaviors. The nature and limits of knowledge and creative expression are discussed. Prerequisite: 47.101 3 cr

47.312 Learning and Behavior

Based on the principles and findings of experimental studies of animal and human behavior, this course examines various methods and techniques suitable for the modification of human behavior with consideration of how such methods can be used in education, mental health and corrections, and self-directed personal change. Prerequisite: 47.101 3 cr

*Consult the Academic Policies section of this catalogue regarding the General Education requirements for mathematics and sciences.

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47.313 Cross-Cultural Perspectives on Women's Lives

This course examines the changing roles and lives of women in contemporary societies. An ecological systems model provides the theoretical foundation for examining how differences between cultures structure women's lives, particularly in terms of health, reproduction, and access to education and employment will be explored. 3 cr

47.322 Gender, Work and Family

This course examines ways that gender is related to contemporary work roles, family roles, and social institutions. Although most women work outside the home and most men have children, the perception that "a woman's place is in the home" and that men are the "family providers" continues to influence personal expectations and social policies. The course will critique current social arrangements and discussion of options for healthier, more equitable alternatives. 3 cr

47.328 Dynamics of Interpersonal Relations

An analysis of psychological dynamics in interpersonal behavior emphasizing such topics as interpersonal communication, self-disclosure, personal styles of interaction, and techniques of change. The primary focus is on the behavior of the students themselves, who are expected to participate in the classroom. The course is taught without a prerequisite but is open only to juniors and seniors. 3 cr

47.332 History of Psychology

Examines the historical roots of psychology from the pre-scientific psychologies of the ancient Greeks to the twentieth century schools of the introspectionists, the Gestalt psychologists, and psychoanalysts. Historical resolutions of recurring issues are contrasted with modern resolutions. Prerequisite: 47.101 3 cr

47.333 Psychology of Consciousness

Introduces students to psychological theories and studies of the mind-body dualism, mind-brain identity, and the emergence of mind. Studies of psychosomatic disease and healing imagery, sleep and hypnosis, "subconscious" perception and "extra sensory" perception, multiple personalities and "split brain" patients are discussed. The questions of animal awareness and computer consciousness are also considered. Prerequisite: 47.101 or 47.278 3 cr

47.335 Psychology and Women

A consideration of such topics as: the psychology of sex differences; biological bases of psychological sex differences; the nature of female sexuality; clinical theory and practice concerning women; women as mental patients and mental health consumers; implications for psychology and for women's status. Taught with no prerequisite but intended primarily for juniors and seniors. 3 cr

47.345 Psychology of Health and Adjustment

An examination of psychological aspects of human health, both physical and mental, and the processes of adjustment and growth. Consideration is given to the interplay of health and illness with emphasis on psychological methods of overcoming and preventing illness and of enhancing physical and emotional well-being. Prerequisite: 47.232 or 47.272 3 cr

47.351 Human Sexuality

The biological, psychosocial and attitudinal aspects of human sexuality are addressed through lectures, discussions, films and from a variety of perspectives. 3 cr

47.352 Psychological Testing

A survey of major tests and techniques used to assess cognitive abilities, personality and vocational interests; an introduction to the various professional settings in which testing and assessment methods are used (e.g., mental health, rehabilitation, employment and personnel selection, criminal justice). Students learn to administer, score, and interpret specific tests and learn how to develop a case study or report based on test data and related information. Prerequisite: 47.101 3 cr

47.360 Human Development II

Begins with an overview of recent theoretical perspectives on adult development and aging. In chronological sequence, it presents the stages of adulthood and later concludes with death and dying. Topics covered include personal, family, and vocational development through adulthood, gender-pattern differences, and the impact of changing demographics including the lengthening of the life span. Prerequisite: 47.260 3 cr

47.361 Problems and Issues in Childhood and Adolescence

Examines specific disorders during childhood and adolescence including neurotic disorders, autism and psychoses, retardation, learning disabilities and conduct disorders. Consideration is also given to developing an understanding of how parent/child interactions may impair healthy development. (e.g. child abuse, neglect, parental alcohol and substance abuse). Prerequisites: 47.101, 47.260 3 cr

47.363 Current issues in Mental Retardation

Presents information about developmental and other disabilities with a focus on mental retardation. Looks at current practices in providing service to people with mental retardation and their families. 3 cr

47.364 Psychology of Crime and Corrections

An investigation of the psychological aspects of crime and deviance and the nature of punishment and rehabilitation. Studies clinical case histories of criminal personalities in conjunction with contemporary psychological theory and research concerning anti-social and delinquent behavior. The nature of prisons, the criminal justice system, and aspects of psychological services, are considered. Prerequisite: 47.101 3 cr

47.365 Language, Self and Culture

This course will address the interrelationship of self and culture as mediated by language. The course will consider various aspects of language and whether language is uniquely human. Lecture topics include language and thought, cultural traditions of storytelling, the representation of self and others, genderlect, dialect, bilingualism, and the social construction of race and racism. 3 cr

47.369 Statistics in Psychology

Introduction to basic statistics used in psychology including descriptive statistics, sampling, the normal distribution, correlation and regression, and inferential statistics (t test, chi-square, analysis of variance). Prerequisite: 47.269 or permission of instructor 3 cr

47.373 Brain, Mind and Behavior

A survey of issues and topics dealing with the physiological and evolutionary bases of behavior. Biological systems and processes that influence behavior are con-

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sidered with particular emphasis on brain mechanisms. Recent discoveries in the neurosciences are presented. Methods of research are reviewed. Prerequisite: 47.101 3 cr

Research Laboratories in Psychology

The following courses satisfy the research laboratory requirement for the major. At least one course will be offered each semester; some will be offered more frequently than others. All laboratory courses involve both lecture and laboratory work, and they are designed to introduce the student to the methods and principles of experimental and/or observational research. Students will conduct their own research under supervision and will be required to submit regular laboratory reports. All research laboratory courses have 47.269 Research Methods as a prerequisite. Students must register for both lecture and the separate laboratory.

47.375 Research Laboratory in General Experimental Psychology

Provides an overview of experimental methodology in several areas of psychology including learning, sensation and perception, cognition and/or social psychology. Students develop skills in designing, implementing and presenting research projects. Prerequisites: 47.269, 47.276 or 47.277 or 47.278 or 47.373 3 cr

47.381 Research Laboratory in Human Factors

The focus is on methods for studying human technical performance at cognitive tasks like pattern recognition and decision making and at psychomotor tasks like typing and operating complex equipment. Laboratory exercises are supplemented where feasible by field visits to technical work settings. Prerequisites: 47.269 or permission; 47.276, 47.277, 47.278 or 47.373 3 cr

47.388 Human Factors in Design and Engineering

This course covers the principles of human factors engineering, its importance and its relevance in a variety of applications. 3 cr

Advanced Seminars

The following 400 level seminars are designed primarily for upperclass majors in Psychology, and any may be used to satisfy the 400 level requirement (six credits) of the concentration. They all carry prerequisites and involve a high degree of independent work in field experience and/or research. Emphasis is on current developments in specialized areas of psychology reflecting the expertise of members of the faculty. The descriptions provided below should be considered only in general terms: seminars are highly individualized and vary considerably in content and approach from one instructor to another. Each semester the Department will post notices providing more detailed descriptions, and students are urged to utilize this information in making their selections. Seminar enrollments will be strictly limited, and a high degree of student participation is expected. Each year at least one specific seminar in each of the general areas will be offered. Students may enroll for as many different seminars as they wish, including as many as two seminars in the same general area, provided only that no seminars taken for credit cover the same specific topics.

47.473 Seminar in Social Psychology

Intensive study of one or more of the following special topics in social psychology: small group interaction; social aspects of health and illness; conformity; attitude formation and prejudice; patterns of communication, including non-verbal communication; psychology of sex roles; methods of social action and social change in the community. Prerequisites: 47.269, 47.209 3 cr

47.474 Seminar in Developmental Psychology

Careful consideration of selected topics in the area of human development including the following: psychology of the family, parent-child relations, infant development, adjustment during adulthood, death, dying, etc. Prerequisites: 47.269, 47.260 3 cr

47.475 Seminar in Clinical Psychology

Focuses on such topics as the following: the nature of psychotherapy and clinical practice, analysis of specific clinical theories of psychopathology and psychotherapy (family systems, Gestalt, behavioral, psychoanalysis), the nature and causes of

specific psychological disorders (schizophrenia, affective disorders, etc.), the nature of mental hospitals, the community mental health movement, clinical methods of assessment, current topics in personality theory and research, etc. Placement may be required. Prerequisites: 47.269 and 47.232 or 47.272 3 cr

47.476 Seminar in Experimental Psychology

Intensive study of specific topics and areas of psychological research from among the following: the experimental analysis of behavior, sensation and perception, cognitive psychology, the biology of behavior, the comparative study of animal behavior, and other selected topics related to experimental psychology. Prerequisite: 47.269; other prerequisites may be specified by the instructor. 3 cr

47.477 Seminar: Contemporary Trends in Psychology

Will be offered from time to time, and deals with issues in contemporary areas of psychological practice and/or research; implications for future developments in the field will be covered. Prerequisite: 47.269; other prerequisites may be specified by the instructor. 3 cr

Directed Study

Directed studies are available only to Psychology majors and may be elected provided that 1) the material to be covered is not available in any course offered during the semester in which a directed studies/advanced tutorial is contemplated, 2) instructors are willing to undertake the supervision of the student's work, and 3) no more than nine credits in the major are acquired in directed studies/advanced tutorials.

Directed studies offer a student the opportunity to engage in an independent study or research project during an academic semester under the supervision of a department member. The topic for such work will be jointly determined by the student and his/her supervisor. Interested students are required to apply to the department prior to registration for the semester in which they wish to enroll. This application must be on a form available from the department and will be reviewed to determine:

- a. feasibility of the proposed work;

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- b. availability of an appropriate faculty member; and
- c. ability of the student to engage in concentrated and sustained effort.

Students are advised to examine the list of department members and their specialized fields of interest before writing their study proposal for the application. Each student who is accepted for a directed study or advanced tutorial will be responsible for submitting a final version of the proposal to the department before the end of the Drop-Add period of the semester during which the work is undertaken. Although no prerequisites have been set, it is expected that the student will approach this study with the basic theory and the academic and technical skills essential in high level work, and ordinarily only juniors or seniors will be considered.

47.491 Directed Study in Psychology

Through frequent consultation with the instructor, the student carries out the investigation of a particularly specialized area of interest. One semester of directed studies (or one semester of practicum, but not one semester of each) may be counted toward satisfaction of the 400 level requirement of the major. 3 cr

47.495 Advanced Tutorial in Psychology

An opportunity for the student to work at the highest level of specialization and independence on a project of his or her own design. Requires careful consultation with the faculty. Prerequisite: 47.491 3 cr

Practicum**47.496 Practicum in Psychology**

A program of practical experience for Psychology majors only. Specific requirements vary, but the practicum experience enables upperclass students to work and study in a variety of areas related to psychological practice and research (mental health agencies, hospitals, prisons, schools, University programs, etc.). Practicum may be repeated for a maximum of nine credits. Students are rated "satisfactory" or "unsatisfactory". The practicum experience may not be substituted for any required course in the major, but only one semester of practicum (or one semester of directed studies, but not one of each) may be counted for the 400 level requirement of the major.

Prerequisite: permission of the department or designated faculty member, which must be obtained before registration the semester in which the practicum is to be taken.

Community and Social Psychology Graduate Courses

For graduate courses in Community and Social Psychology, consult the "Graduate School Catalogue"

Department of Sociology

Carol Brown, Chairperson

Professors: Levon Chorbajian, Mitra Das, Nancy Kleniewski, Shirley Kolack (Emerita)

Associate Professors: Carol Brown, Frederick Sperounis

Affiliated Faculty: John MacDougall, Arlene McCormack

The Sociology Department provides a solid foundation in sociological knowledge, theory, and methodology. Its graduates are well-informed citizens who often continue graduate or professional studies, pursuing careers in law, health-care and teaching, as well as traditional opportunities in the social services.

The Department of Sociology offers a major leading to the B. A. degree and a minor area of studies.

Sociology Major

The major in Sociology offers students the opportunity to understand the nature of social life in our own and other societies. It provides a unique perspective from which to gain a systematic view of material in a large number of different fields. Courses in the Department cover a wide range of fields and encompass such topics as ethnic cultures, the dynamics of social policy, relationships between sexes, the nature of industrial capitalism, and the impact of technology on modern society. Students are encouraged to do work in the Lowell area as part of the sociology program. A prevalent value within the Department is the search for meaningful social change. Students who are interested in working in human services, personnel management, urban planning, elder services, communications, law, teaching or full-time academic work might consider a major in Sociology.

Summary of Degree Requirements**University General Education Requirements**

Sociology majors entering in fall, 1993, and after must conform to the new University General Education

Department of Sociology

Requirements outlined in the appropriate section of this document.

Note: Courses taken to satisfy the requirements of a major or minor cannot be used to fulfill core requirements.

Major Field Requirements (36-45 credits)

Effective with the class of 1995 (entering the University in September 1991) and all subsequent classes, Sociology majors must fulfill the following requirements:

- 48.101 Introduction to Sociology
- 48.321 Social Theory I
- 48.322 Social Theory II
- 48.402 Sociological Research I
- 48.403 Sociological Research II
- 48.4 one other 400 level course (excludes 48.496 Practicum)

In addition, majors must complete at least 12 credits (four department courses) at the 300 level or above.

Note: Students entering before September 1991 are not required to take 48.322 or 48.403 (30-45 credits)

The maximum number of directed studies, theses and/or practica is 12 credits.

Language Requirement

Sociology majors are required to evidence intermediate language proficiency and must satisfy this requirement by conforming to the guidelines outlined in the appropriate section of this document.

Note: Courses taken to satisfy the language requirement cannot be used to fulfill University General Education Requirements.

Unrestricted General Electives

Within the guidelines outlined in the appropriate section of this document, Sociology majors are required to complete their minimum total credit requirements for the degree in sociology (120 credits) by electing courses in other university academic departments.

Concentrations

Sociology majors may choose a concentration of study from the options below. Students will take four courses in their area of concentration, one of which should be a seminar or a field placement for the human services concentration. Students can choose a thesis option as part of the concentration. A non-sociology course can be substituted for one course within the concentration with the permission of the Department Chair and the course instructor. Non-sociology courses cannot be used for the general major (i.e., without a concentration).

Concentration Options

- a. Human Services: Sociology of Deviance, Sociology of Law, Sociology of Health, Sociology of Family, The Study of Minorities, Social Services, Field Placement.
- b. Peace and Conflict: Black Experience in American Life, Nuclear Weapons, Values & Society, Sociology of Non-Violence, Social Stratification, Peacemaking Alternatives, Human Rights, Seminar on War & Peace.
- c. Technology & Society: Nuclear Weapons, Values & Society, Reproductive Technology, Technology & Human Values, Mass Media, Seminar on Mass Communication, Seminar on Industrial Lowell.

Thesis Option

This involves advanced reading, research and analysis in selected topics in sociology. Students taking this option are strongly advised to do so in the fall semester of the senior year. No more than six credits can be taken for thesis. There will be two readers for the thesis, one of whom will be the thesis advisor. Students will be asked to defend the thesis.

Transfer Students

Students transferring to the College and wishing to major in Sociology must make individual arrangements with the Department Chairperson regarding satisfaction of major course requirements.

Sociology Minor

A minor area of study consists of 18-24 credits of coursework in sociology. At least six credits must be taken in coursework at the 300 level or above.

Sample Course of Study for Sociology

For students entering the University in Fall 1993 and subsequently

Beginning with the class of 1995 (freshmen entering the college in the Fall of 1991), a major in sociology consists of 36 to 45 credits with at least 27 credits at the 300 level or above (includes required and elective courses in the major).

Freshman Year

Fall Semester

42.101	College Writing I (Gen Ed)	3
92.	Mathematics* (Gen Ed)	3
48.101	Introduction to Sociology	3
	Beh & Soc St (Gen Ed)	3
	Beginning Language I	3
		15

Spring Semester

42.102	College Writing II (Gen Ed)	3
	Science* (Gen Ed)	3
	Historical Studies (Gen Ed)	3
48.	Sociology or Free Elective	3
	Beginning Language II	3
		15

Sophomore Year

Fall Semester

48.2	Sociology Elective	3
48.	Sociology or Free Elective	3
	Beh & Soc St (Gen Ed)	3
	Science* (Gen Ed)	3
	Intermediate Language I	3
		15

Spring Semester

48.321	Social Theory I	3
48.	Sociology or Free Elective	3
	Literature (Gen Ed)	3
	Values, C & C (Gen Ed)	3
	Intermediate Language II	3
		15

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Junior Year

Fall Semester

48.402	Sociological Research I	3
300/400	Sociology Elective	3
	Science* (Gen Ed)	3
	Aesthetics (Gen Ed)	3
	Free Elective	3
		15

Spring Semester

48.403	Sociological Research ii	3
300/400	Sociology Elective	3
300/400	Sociology Elective	3
	Free Elective	3
	Free Elective	3
		15

Senior Year

Fall Semester

48.322	Social Theory II	3
300/400	Sociology Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

Spring Semester

48.	Sociology Elective	3
48.4	Sociology Elective	3
	Free Elective	3
	Free Elective	3
	Free Elective	3
		15

*Refer to the Academic Policy section of this catalogue for the General Education requirements for mathematics and sciences.

**for class of 1995 and beyond

Sociology Courses (Prefix: 48)

48.101 Intro to Sociology

Basic course in sociology. Emphasis is directed at the ways in which social institutions such as government, schools, the economy, social class, and the family develop and influence our lives. It is concerned not only with presenting various ways to understand our relationship to society but also with ways to change it. Prerequisite to all 300 and 400 level sociology courses 3 cr

48.110 Intro to Social Values

A sociological analysis of belief systems in contemporary United States. The different perspectives held by social groups are shown, and students are encouraged to examine their own perspectives. The role of churches, governments and families in conserving and changing the social structure of modern society are examined. Beliefs are related to political and economic interests and conflicts. Historical and international comparisons are made. 3 cr

48.201 Social Anthropology

Using the comparative approach to society, this course examines several distinct cultures as a means of understanding both the universal constants and the variations in human societies. 3 cr

48.212 Cultures of the World

Focuses on a different country or region each time it is given. Students examine the traditional culture, recent history, economic development, class structure and international relations of the area covered. See the Department Chairperson for specifics 3 cr

48.215 Peacemaking Alternatives

Examines various positive alternatives to war and violence, including disarmament, nonviolence, conflict resolution, and the United Nations. Students do volunteer work with an activist agency or interview an activist. The course stresses the historical and contemporary role of peace movements and allied social-change movements such as feminism, civil rights and environmentalism. 3 cr

48.220 Self Assessment and Career Development

Study of the meaning of work in our society. Class participants assess their own life experiences, keep journals and develop a plan to integrate their interests, values and abilities into meaningful and realistic life/work patterns. 3 cr

48.231 Sociology of the Family

Study of the nature of the family in contemporary society with particular emphasis on the family in America. What functions does the family perform in modern society. How is it changing? How do these changes affect our lives? 3 cr

48.234 The Study of Minorities

Examines the process of immigration and majority-minority relations in the United States over the last century with particular emphasis on the process of adaptation in a pluralistic society. The treatment of minority groups in other societies is examined as well. 3 cr

48.251 Community Service

Course uses field work approach to understand social problems and to discipline study and career pursuit in the area of public service. 3 cr

48.255 Social Deviance

An analysis of behavior considered deviant, such as drug abuse, crime and mental disorders. Attention is paid to cultural definitions of deviance and to social institutions that treat people defined as deviant. 3 cr

48.256 Political Sociology

Focuses on the development and use of power in modern society. Emphasis is placed on the relationship of American political institutions to economic institutions, to social class, and to supporting ideologies. 3 cr

48.260 Mass Media & Communications

Course investigates the structure of mass communications and the impact of the media on our lives. A full range of media are considered including television, radio, cinema, and the press. The potential impact of new media sources are also considered. 3 cr

48.303 Sociology of American Education

Course introduces students to ongoing debates in the field of Sociology regarding the American educational system, its structures and functions and how it relates to issues of inequality by race, class and gender. Students are expected to explore, examine and evaluate the current issues relating to the system of education in the United States. 3 cr

48.305 Sociology of Family Law

Examines some social issues in family law, the changes therein and the social climate and consequences accompanying these. By using the sociological method of enquiry to examine family law cases, the relationship between law and society as instruments of order and change are exemplified. 3 cr

48.314 Nuclear Weapons, Values and Society

An examination of popular values and conceptions concerning nuclear weapons, and of the political, diplomatic and economic issues surrounding these weapons. A detailed consideration of the strategic and political interests of the major powers; of current political and economic changes in Europe and Soviet Union; and of nuclear weapons proliferation in developing countries; a discussion of alternatives to the nuclear arms race, e.g., global security or non-provocative defense. 3 cr

48.321 Social Theory I

Examines major sociological theories, both historic and contemporary. Students learn how theory is created, and how it is linked to facts. Prerequisites: 48.101, plus one other sociology course 3 cr

48.322 Social Theory II

An in-depth critical examination of major theorists in sociology. Students learn about their impact on the development of existing social thought. Prerequisite 48.321 for non majors. Prerequisite for majors: 48.321 3 cr

48.323 Sociology of Ideas and Values

A consideration of the ways in which ideas and values arise in society and in turn influence social action. Included are scientific facts, myths, ideologies, religions, morals, and common sense beliefs. 3 cr

48.331 Sociology of Reproductive Technology

In vitro fertilization, artificial insemination, surrogate motherhood, genetic engineering, birth control, childbirth are issues examined. Social attitudes towards women and reproductive rights are included. Prerequisites: 48.101 and two sociology or two women's study courses 3 cr

48.335 The Black Experience in American Life

Careful examination of the role and status of Blacks in the United States since slavery. Prejudice, racism, and black separatism are emphasized. 3 cr

48.340 Sociology of Sports

Examines the history of modern sport at the amateur and professional level and international competition. The impact of race, sex, economics and politics on the institution of sports are also examined. 3 cr

48.341 Social Stratification

Focuses on the phenomenon of social class distinctions with particular emphasis on social class in America. The approach is both historical and sociological. 3 cr

48.345 Urban Sociology

Deals with issues related to the quality of life in American cities. Students taking this course may engage in research projects on the city of Lowell and the role of the University of Massachusetts Lowell within that city. 3 cr

48.350 Social Service

An examination of the structure of social welfare services in America. Attention is directed at the functions that welfare and mental health institutions serve in American society; the attitudes and values that surround these institutions; and the role of the social worker within them. 3 cr

48.351 The Sociology of Health and Health Care

A historical and contemporary study of the socio-politics of health, illness, and the health care industry in the United States. Attention is given to providers, consumers, owners, workers, and professionals in terms of their power, class, race, sex, and age. Reforms and alternatives are considered. 3 cr

48.352 Sociology of Non-Violence

An analysis of non-violent efforts to achieve social change through demonstrations, civil disobedience, etc. Movements led by Mahatma Gandhi, Martin Luther King, Jr., and others are examined. 3 cr

48.357 The Sociology of Religion

An investigation of religious institutions and experiences. Emphasis is placed on the influence of religion on social change. 3 cr

48.361 The Sociology of Law and the Criminal Justice System

Introduction to the theory, structure, ideology, and practice of the criminal justice system. Particular attention is directed at the definition of crime and the impact of social, political, and economic policy on the operation of systems and their impact on its "clients." 3 cr

48.370 Women in Society

The women's movement has changed our accepted views of women and men. The course seeks an understanding of the posi-

tions of women and men in culture, the economy, the family and political life. Crucial are the questions "what do we want?" and "what do we need?" Specific topics are examined. 3 cr

48.382 Social Movements

Considers organized action undertaken to alter the social position of a group. Organization, techniques of action, motivation of participants, and group ideologies are studied. Materials from historical, social, psychological, and sociological sources are used. 3 cr

48.388 Seminar on Industrial Lowell

The seminar analyzes and discusses the growth, decline and rebirth of Lowell, Massachusetts. Special attention is given to shifts in technology and changes in work relationships, e.g., from farm women to immigrant labor force to high technology. Lowell's rich past and present is observed first hand by using the city as a laboratory. 3 cr

Advanced Sociology Courses

The following courses are intended primarily for upper-class majors. Students need a minimum of four courses in sociology, including 48.101, before enrolling in these classes. Contact the Department Chairperson or instructor for more information.

48.402 Sociological Research I

De-mystifies statistics and computers by familiarizing students with both the statistics commonly used in social investigation and computer software designed to handle social science data. Both are used within the context of social investigation. For majors only. 3 cr

48.403 Sociological Research II

Emphasizes field work involving social problems associated with various work settings. Students learn about different strategies employed in qualitative field research by undertaking a case study of their choice. For majors only. 3 cr

48.404 Field Placement

Provides students with the opportunity to directly observe and participate in the operation of a social service organization. Prerequisites: 48.350 and permission of instructor 3 cr

COLLEGE OF ARTS AND SCIENCES*Department of Sociology***48.421 Seminar on the Family**

Study of the family structures and gender roles in various human societies.

Prerequisites: 48.101 plus either 48.231 or 48.241 3 cr

48.450 Seminar on Peace, Violence & War

A research seminar on the social, cultural, political and economic aspects of war and peace. Special emphasis placed on ways to make and maintain peace in the world and particular regions. Prerequisite: permission of the instructor 3 cr

48.466 Seminar in Class, Status and Power

Emphasizes the impact of class, status, and power relationships on the social organization of past and present societies. Special attention is focused on processes for redistributing privileges and rewards in society. Prerequisites: 48.341 or 48.256 and permission of instructor 3 cr

48.468 Seminar: Multiculturalism

Course defines the scope of multicultural studies, acquaints students with the parameters of ongoing debates and seeks ways to enrich and further this debate. 3 cr

48.469 Selected Topics

Concentrates on a different area of sociology each time it is taught. See the Department Chairperson for more information 3 cr

48.479 Senior Seminar

The class reads and analyzes books on a variety of subjects. Prerequisite: permission of instructor 3 cr

48.484 Industry Internship

Open to all majors in Humanities and Social Sciences. Practical experience of work using liberal arts skills in private industry and/or using high technology. Prerequisite: permission of instructor 3 cr

48.485 Industry Internship II

A continuation of 48.484 3 cr

Directed Studies

Directed study courses are available only to majors in Sociology and may be taken provided that 1) the material to be covered is not available in any course offered during the semester in which a directed study course is contemplated, and 2) instructors are willing to undertake a directed study course.

48.491 Directed Studies in Sociology

The student, through regular and frequent consultation with an instructor, develops a course of directed reading in sociology and defines a problem for individual research. Prerequisite: permission of instructor 3 cr

48.495 Thesis in Sociology

A program of study which affords the advanced student with an additional opportunity to pursue a previously explored problem in greater depth or to initiate a new study. The purpose is to sharpen and refine techniques for scholarly research and presentation in the student's major discipline. Prerequisites: demonstrated proficiency in an area selected for directed study and permission of instructor 3 cr

Practicum**48.496 Practicum Experience**

A program of on-campus and/or off-campus experience for sociology majors and minors only. Specific requirements vary depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural, or artistic area and for applying techniques of problem solving and/or skills which are appropriate to the student's major discipline. May be repeated to a maximum of six credits. Students are graded "satisfactory" and "unsatisfactory." The practicum experiences may not be substituted for a required course in the major. Prerequisite: permission of Chairperson 3 cr

Interdisciplinary Programs and Minors**Classical Civilization**

Christos Bentas (History), Coordinator

Coursework for a minor area of study in classical civilization is selected in consultation with Dr. Christos Bentas of the History Department from the following disciplines: art, classics, English, history, Greek, Latin, philosophy, and western cultural heritage. Coursework for the classical civilization minor must be distributed in three areas with at least nine hours in one area, six hours in a second area, and three hours in a third area. Although courses in Latin or Greek are not required for the minor, students are urged to complete at least six hours of the minor in a classical language at the intermediate level. At least six hours must be taken in coursework at the 300 level or above.

Cognitive Science

Robert Kunzendorf (Psychology), Coordinator

A minor in Cognitive Science is designed primarily for the electrical engineering or computer science student who is interested in artificial intelligence. This interdisciplinary minor exposes the student to three methods of studying mental processes: philosophic and linguistic analysis, psychological experimentation, and computer simulation. Coursework in the minor in cognitive science is selected in consultation with Dr. Robert Kunzendorf of the Psychology Department.

The minor consists of 18-24 credits: at least six credits from each area and at least six credits at the 300 level or higher. Technical electives and approved electives may be used to fulfill the area C requirement. Core courses in area A or area B may be applied both to the university core requirement and to the cognitive science minor. Some prerequisites for the following courses in the cognitive science minor may be waived, with instructor consent.

A. Philosophic and Linguistic Analyses of Cognition

- 42.308 Analysis of Modern English
- 42.431 Contemporary Linguistic Theory
- 45.301 Theory of Knowledge
- 45.305 Language, Signs, & Symbols
- 45.312 Philosophy of Science
- 45.331 Philosophy of Mind

*Interdisciplinary Programs and Minors***B. Psychological Experimentation on Cognition**

- 47.276 Theories of Learning
- 47.277 Sensation and Perception
- 47.278 Cognitive Psychology
- 47.333 Psychology of Consciousness
- 47.373 Mind, Brain, and Behavior

C. Computer Simulations of Cognition

- 16.522 Data Structures
- 92.459 Artificial Intelligence
- 92.465 Formal Languages
- 92.466 Theory of Computation

Film Studies

Mario Aste (Languages), Coordinator

The interdisciplinary minor in Film Studies consists of 18-24 credits of coursework. Six credits at the 200 level or above are required for the Italian language component. Additional courses to complete the required credits may be selected from the following list or other course listings in this catalogue.

- 42.230 Film Classics
- 42.234 The Documentary Film
- 42.241 Women in Film
- 50.376 French Cinema & Society
- 50.378 Women in French Cinema
- 50.374 Classics of Italian Cinema
- 52.378 Italian Cinema & Culture
- 52.380 Italian Cinema: Themes and Directors

At least six credits must be taken in coursework at the 300 level or above. The list of approved courses may change from time to time depending on the offerings of the several departments involved; students should check with the appropriate coordinator to see which courses are currently approved.

German Studies

Mario Aste (Languages), Coordinator

The interdisciplinary minor in German Studies consists of 18-24 credits of coursework. Six credits at the 200 level or above are required for the German language component. Additional courses to complete the required credits may be selected from the following list or other courses currently listed in this catalogue.

- 43.217 Renaissance and Reformation

- 43.222 Europe in the 20th Century
- 43.255 History of Germany to 1871
- 43.337 History of Germany Since 1871
- 58.323 Northern Renaissance Art
- 59.320 Northern Baroque Culture

At least six credits must be taken in coursework at the 300 level or above. Beginning courses in German at the 100 level may not be credited to the German Studies minor.

The list of approved courses may change from time to time depending on the offerings of the several departments involved; students should check with the Chairperson of the Language Department to see which courses are currently approved.

Italian Studies

Mario Aste (Languages), Coordinator

The interdisciplinary minor in Italian Studies consists of 18-24 credits of coursework. Six credits at the 200 level or above are required for the Italian language component. Additional courses to complete the required credits may be selected from the following list or other course listings in this catalogue.

- 43.313 Renaissance and Reformation
- 52.315 Italian American Literature and Cinema
- 52.371 Dante's Divine Comedy
- 52.373 Italian Humanism
- 52.376 Pirandello: Theatre and Influence
- 52.378 Italian Culture and Cinema & Literature
- 58.321 Italian Renaissance Art
- 58.322 Baroque Art in Italy

At least six credits must be taken in coursework at the 300 level or above. Beginning Italian courses at the 100 level may not be credited to the Italian minor.

The list of approved courses may change from time to time depending on the offerings of the several departments involved; students should check with the Chairperson of the Language Department to see which courses are currently approved.

Latin American Studies

George Luter (History), Coordinator

Courses for a minor field in Latin American studies are selected in consultation with Professor George Luter of the history department from a list of approved courses in history, economics, languages, and literature. Six credits at the 200 level or above are required for the Spanish language component. Coursework for the Latin American Studies minor must meet the following distribution requirement:

Spanish Language	6 cr.
History/Economics	6-9 cr.
Latin American Lit	6-9 cr.

At least six hours in non-language courses must be taken in course work at the 300 level or above.

Students majoring in Spanish or Modern Languages (with Spanish option) may elect the Latin American studies minor but may not offer any course in Spanish language or literature (prefix: 54) as part of the 18-24 semester credits.

Peace and Conflict Studies

John MacDougall (Sociology), Coordinator

Social conflicts are probably inevitable in human societies, but it is preferable to devise constructive ways, short of large-scale violence, for resolving conflicts.

The goals of the Peace and Conflict Studies minor are:

- a. to communicate basic facts and insights regarding war and large-scale conflicts, especially in the contemporary world;
- b. to discuss efforts and proposals for peacemaking, together with their principal strengths and weaknesses; and
- c. to develop a critical yet respectful and informed awareness of the diversity of policies and values about war and peace.

Requirements for the Minor

Any undergraduate can minor in Peace and Conflict Studies (PCS). A minor must take:

- a. five to seven courses from the list available from the PCS coordinator, of which

COLLEGE OF ARTS AND SCIENCES*Interdisciplinary Programs and Minors*

at least one must be at the 300 or 400 level. These courses are in English, History, Philosophy, Political Science, Sociology and Languages;

b. **Peacemaking Alternatives, 48.215**

PCS minors can also choose from a list of PCS courses available at other schools in the NECCUM consortium, including the Peace Studies Minor at Salem State College. Where a PCS course meets the university core requirement in Values, it can also be used to meet that requirement; and

c. **Seminar on War & Peace, 48.450**

Technology, Society and Human Values

The courses offered in this program are interdisciplinary in their content and structure and are designed to explore a topic in greater depth and from broader perspectives than is ordinarily possible in other courses. Many courses are team-taught by faculty chosen from various academic departments and colleges within the University. Courses emphasize the sources (scientific, philosophical, and historical) of the period studied and the interrelationship of technology and human values.

A minor in Technology, Society, and Human Values consists of 18 to 24 credits of coursework. At least six credits must be selected from courses which are numbered 300 and above. With approval, related courses, other than those specifically listed below, may be offered to satisfy the minor. For more information, contact the Dean of Humanities and Social Sciences.

Technology, Society and Human Values Courses (Prefix: 59)

59.203 Technology and Human Values I

A team-taught course on interrelationship of technology and human values. It explores the industrial revolution in Lowell, followed by an examination of topics drawn from areas such as agriculture, third world development, population control, energy and natural resources, household technology, and transportation.

Unifying themes are the values associated with science and technology, the role and responsibility of the scientist and technologist, and the question of whether scientific and technological development should be and can be controlled. 3 cr

59.204 Technology and Human Values II

A continuation of 59.203. 3 cr

59.214 Nuclear Weapons, Values and Society

Examines popular values and conceptions concerning nuclear weapons, and of the political, diplomatic and economic issues surrounding those weapons. Analyzes the strategic and political interests of the major powers, and alternatives to the nuclear arms race. MacDougall 3 cr

59.303 Understanding Technological Risk

How safe is safe enough? Who really was Dr. Frankenstein? Was it possible not to create the A-Bomb? What do Elvis and Adolph have in common? Learn how viewing the same phenomena from two different disciplines can enhance decision-making capabilities crucial to survival in a technological age. A nuclear engineer and a literary scholar together examine the many value issues involved in understanding the nature of technological risk and its impact on modern society. Focusing on questions of scientific responsibility and social safety, students examine changing attitudes about technology and values, using novels, films, historical accounts, guest lecturers, panel discussions and debates. G. Brown 3 cr

59.306 Evolutionary Thought

Considers the impact of Darwin's evolutionary theory on modern biological science, social thought, and literature. 3 cr

59.309 The Engineer in Society

Examines the role of the engineer in society from an interdisciplinary perspective. How has this role changed? What can be expected for the future? The engineering personality, ethics and engineering, and engineers in industry are covered. The format of the class encourages discussion of the issues. Each student prepares a substantial report on a topic of personal interest. G. Brown, Liebowitz 3 cr

59.321 Literature on Technology and Human Values

Examines nineteenth and twentieth century literature to understand the impact of modern technology on the development of ethical values. Possible readings include Atwood, *The Handmaid's Tale*; DeLillo, *The Names*; Dick, *Blade Runner*; Hoffman, *At Risk*; Huxley, *Brave New World*; and Shelley, *Frankenstein*. 3 cr

59.330 Political, Social, and Technological Alternatives

Examines alternatives to the organization and dominant values of Western technological society, explores work, political systems, family, and technological change. 3 cr

59.333 Technology and Gender

Analyzes gender perspectives of technology, focusing on invention, work, values, and new technologies. 3 cr

59.350 Seminar in Technology and Human Values

Intensive study of selected topics. 3 cr

59.388 Seminar in Industrial Lowell

An interdisciplinary course on the growth, decline and rebirth of Lowell, MA from its inception as the first planned industrial city to the present. This course complements the establishment of the first Urban National Park in Lowell. 3 cr

59.395 Computers in Society

Explores the history of computers and their interaction with contemporary society. It begins by looking at the nature of computers and their development from Charles Babbage to the present and continues with a series of specific examples dealing with the possibilities and problems arising from the use of computers in different areas of contemporary life. Examines the use of computers in education, the military, and business. The final section deals with the issues of individual freedom and control. Encourages students from many disciplines to examine critically the place of this new machine in their lives. Liebowitz 3 cr

59.420 Project in Technology and Human Values

Student projects involving technology, society and human values. 3 cr

*Interdisciplinary Programs and Minors***59.501 Advanced Seminar in Technology and Human Values**

Intensive study on the graduate level of selected topics in technology, society and human values. 3 cr

58.490 Art, Science and Technology

Examines the interrelationship between the visual arts and technological/scientific developments in selected historical frameworks. Demonstrates the close correlation between the artist, society and science/technology. It suggests how technology responds to the requirements in artistic endeavors, and how the artist's awareness of, or need for, new technology stimulates revolutionary changes in painting, sculpture or architecture. Cheney 3 cr

Western Cultural Heritage

Peter Blewett (History), Coordinator

The interdisciplinary minor in Western Cultural Heritage requires 18-24 credits of coursework. At least six credits must be from courses which are numbered 300 or above.

The courses offered in this program are interdisciplinary in their content and structure and explore a topic in greater depth and from broader perspectives than is ordinarily possible in other courses. Many courses are team-taught by faculty chosen from various academic departments and colleges within the University. Courses emphasize the sources (artistic, literary, philosophical, and historical) of the period studied and focus on the aspirations and achievements of our own civilization.

Western Cultural Heritage Courses (Prefix: 59)**59.205 Human Values in Western Culture I**

Addresses some of the important questions of human existence through a close study of representative literary, philosophical, and religious texts from ancient times to the present and relevant modern works in the behavioral and political sciences. In the first semester the students explore and evaluate three perennial themes: the problem of evil, self and society, freedom and fate. In the second semester course, the thematic units are: the pursuit of knowledge, the nature of humankind, and the experience of love. 3 cr

59.206 Human Values in Western Culture II

A continuation of 59.205. May be taken independently of 59.205 3 cr

59.208 Western Cultural Heritage I

The actual development of a culture proceeds on many levels at once; the art, literature, philosophy and social structure of a given historical period evolve together, interact with one another, and eventually give rise to a new era. These courses are designed to capture the richness of the various periods of western civilization, to discern networks of dependency and influence among the diverse aspects of epoch's culture and to trace lines of continuity between one age and another. The first semester will treat the period from ancient civilization to the Protestant reformation; the second semester will focus on developments from the seventeenth through the twentieth centuries. 3 cr

59.209 Western Cultural Heritage II

A continuation of 59.208. May be taken independently of 59.208, Western Cultural Heritage I. 3 cr

59.248 Values in American Culture

Examines the relationship among American views on humanity, nature and democracy and shows how these relationships affect attitudes towards the individual, the "American Dream," science and technology. Readings are selected from authors as diverse as the Puritans, the ex slave Douglass, Wharton, Hemingway and Oppenheimer and include such genres as the essay, the short story, autobiography and the magazine article. Topics to be considered include immigration, technological invention, and the modern application of democratic principles to the business community. The course shows how an evolving system of values in America is a factor influencing both individual and national decisions. Lewis 3 cr

59.313 The Culture of Ancient Greece

No one term can capture completely the richness of Greek culture, but there is one which comes closer than any other: TO KALON, which means nobility, goodness, or beauty. Taking this term as a guideline, we explore the many facets of Greek culture by focusing upon social and political structures, the development of moral consciousness, and the appreciation of beauty. These issues are approached through the examination of developments in Greek art

as well as through reflection upon works by Greek poets, dramatists, philosophers and historians. Blewett, Cheney 3 cr

59.314 Society and Culture in the Early Middle Ages

Explores the political, social and cultural transformation which took place in Europe during the five centuries following the collapse of the western Roman Empire. Drawing from historical, literary, linguistic and artistic sources. The classes and lectures focus on the classical, Christian, Germanic and Celtic contributions to the new society and culture that was being created in Europe at this time. A major aim of the course is to make the students aware of how this formative period of the early Middle Ages can help us understand the full achievements of medieval society and culture at its zenith and, ultimately, the European civilization to which it gave birth. Aste 3 cr

59.315 Islamic Culture and Medieval Europe

Helps the student to understand the major tenets of Islamic culture and to analyze its growth and dissemination in the Mediterranean basin. Examines the relationship of Islamic culture to medieval Europe via Moorish civilizations of Spain and, to a lesser extent, of Sicily. Aste 3 cr

59.320 16th Century Italian Culture

Examines the literary, artistic and musical works of the Italian Renaissance in the sixteenth century, focusing on the theories governing the creation of these works, their backgrounds in classicism, their inter-relationship as a part of the humanistic movement, changes in modes of representation and the emergence of new genres. Examines the socio-historical conditions leading to the ideal of "universality," to the role of the Italian courts and academies in fostering the arts, and to the historical development of the Reformation and counter-Reformation. Cheney 3 cr

59.330 17th Century European Culture

Examines views of the individual and the emergence of the modern state. Concentrating primarily on France, England and the Netherlands, we examine the political and social organizations of these emergent nations, and the various views of human nature which are expressed in their literature, philosophy and art. A principal goal is to discern how

the art-forms and ideas of individuals influence and are influenced by the social and political structures around them. Blewett, Cheney 3 cr

Women's Studies

Susan Gallagher (Political Science),
Coordinator

Overview

Women's Studies is an interdisciplinary program offering a minor option and elective courses at both introductory and advanced levels. Women's Studies is also a concentration in the Bachelor of Liberal Arts Program. This program provides students with an opportunity to gain understanding of issues related to the conditions of women's lives and to explore how feminist scholarship provides tools for transformed understanding of the disciplines, human behavior, and social institutions. The Women's Studies Program is administered cooperatively by a Steering Committee composed of faculty from a number of disciplines and student representatives. The Program organizes campus-wide meetings and events open to all members of the University community.

Courses in Women's Studies critically examine the experiences and acknowledge the contributions of women of different races, classes, sexual orientations, and cultures. Currently, most Women's Studies courses are jointly offered with other departments or programs.

Minor Requirements

The Women's Studies minor consists of 18 to 24 credits in cross-cultural interdisciplinary courses, six credits of which must be at the 300 level or above. Students are encouraged to take 59.240, Introduction to Women's Studies. The following courses are approved for Women's Studies credit:

Note: A student may take women's studies courses listed below which are in her/his major field and designate them for the Women's Studies minor, provided that the total number of credits in the major field which the student offers toward the 120 credit minimum required for graduation still not exceed forty-five.

Women's Studies Courses

Interdisciplinary Courses

59.240 Introduction to Women's Studies

This course is an Interdisciplinary introduction to the field of Women's Studies that examines both commonalities and differences among diverse groups of women. A variety of topics are presented such as past and present stratification in work and family, sexual identities, medial representations of women, and violence against women. Social movements for women's equality and feminist theories and methods are also introduced.

59.307 Gender Issues in 19th Century American Literature and Popular Culture

In the 19th century, Americans consciously sought to define themselves, calling for a recognizable literature that would illuminate and celebrate national character. Defining the roles, behaviors, and even the very nature of men and women in the republic became an important corollary to this endeavor. These definitions and values were promulgated not only through traditional arts and literature, but also through magazines, etiquette manuals, and advertisements. We will examine selected texts from high and popular culture to see how gender operates to define individual character and to illuminate social issues, public images, and national myths. 3 cr

59.308 Gender Issues in 20th Century American Literature and Popular Culture

In the 20th century, attitudes toward the gender roles defined by 19th century Americans underwent enormous changes which are reflected in all aspects of culture, both "high" and popular. As first movies then television came to dominate leisure time, the images mass media conveyed of stereotypical male and female behavior played a major role in defining perceptions of gender roles. This course will examine these changing perceptions and their implications in novels, film and television. 3 cr

59.310 Gender Violence in the United States

This course examines the gender implications and underlying assumptions about women and men that are implicit in our laws dealing with gender violence, theo-

ries of violence and crimes, and responses to this violence by our justice system. In the first part of the course, we will examine some of the theories of gender domination and inequality. In the second part of the course we will apply our theoretical insights to the specific applications of gender violence and oppression. We will consider both individual acts of violence such as rape, incest, sexual abuse, wife and child battering and gay bashing as well as harmful acts in institutional violence including sexual harassment, pornography and corporate violence. 3 cr

59.311 Men, Women, and the Military

War and military affairs have traditionally been considered "men's business." This course will examine both the expectations and the reality of this gender assignment. We will look at the roles both men and women have played in past wars and in the nation's military policies. We will consider why this has been, and ask how the situation is changing as women become a greater proportion of the USA's armed forces. 3 cr

59.312 Issues in Human Reproduction

Birth control and abortion enable couples to have sex without having babies; new reproductive technologies like in-vitro fertilization enable couples to have babies without having sex. Public policies as well as individual activities affect changes in sex, marriage, childbearing, and other issues in human reproduction. We will see how the roles of men and women are affected by these changes in motherhood and fatherhood. 3 cr

59.322 Gender, Work and Family

This course examines ways that gender is related to contemporary work roles, family roles, and social institutions. Why is it that men rise to the top in "women's professions," while women do not in male fields? Why are mothers treated differently from fathers in the workplace and why is housework not seen as work? Why do we idealize the "nuclear" family when most people live in other kinds of families? Exploring relationships among gender, paid work and diverse types of families will allow us to critique current social arrangements and to discuss options for healthier, more equitable alternatives for the future. 3 cr

Interdisciplinary Programs and Minors

The following courses are also approved for the minor in women's studies: (descriptions are found under the appropriate department listing):

Legal Studies

- 41.381 Women and the Law

English

- 42.240 Literature and Women
42.241 Women in Film
42.243 Contemporary Women Writers
42.244 Women in the Middle Ages and Renaissance
42.335 American Women Novelists
42.345 Female English Novelists

History

- 43.266 Family in Western Society
43.270 Women in American History
43.380 Work and Society
43.385 History of Family and Childhood in the U.S.

Criminal Justice

- 44.360 Gender, Race and Crime
44.477 Domestic Violence

Political Science

- 46.220 Introduction to Women and Politics
46.320 Women and Politics: Feminist Political Theory

Psychology

- 47.322 His Job/Her Marriage: Gender, Work & Family
47.335 Psychology and Women
47.351 Human Sexuality
47.523 Women in the Community (permission of instructor required)

Sociology

- 48.110 Introduction to Social Values: Patriotism, Religion and Motherhood
48.220 Self-Assessment and Career Development
48.231 Sociology of the Family
48.241 Women in Society

- 48.305 Sociology of Family Law
48.331 Seminar: Reproductive Technology
48.421 Seminar on the Family

Economics

- 49.305 Women, Minorities and Immigrants in the Labor Force

Languages

- 50.378 Women in French Cinema
52.330 Italian Women Writers
54.330 Spanish/Latin American Women Writers

Regional Economic and Social Development

- 57.353 Managing Workplace Diversity

Music

- 74.354 Women in Music

Art

- 58.340 Women and Art
58.490 Art History Seminar: Women Artists

Related courses: additional courses that include considerable material on gender issues or courses in which the instructor encourages and accepts projects or papers on women and gender issues may also be approved for the minor, contingent on approval of the Coordinator or Steering Committee.

Faculty**Deans**

Nancy Kleniewski, A.B., M.A., Ph.D.,
Dean of Humanities and Social Sciences

Robert H. Tamarin, B.S., Ph.D., Dean of
Sciences

Chairpersons

Robert D. Lynch, A.B., M.S., D.Sc.,
Biological Sciences

Stanley C. Israel, B.S., Ph.D., Chemistry

James Canning, B.A., M.S., Ph.D.,
Computer Science

Eva Buzawa, A.B., M.S., Ph.D., Criminal
Justice

Arnold L. O'Brien, A.B., M.S., Ph.D., Env.,
Earth, and Atmospheric Sciences

William H. Roberts, B.A., B.Sc., M.A.,
Ph.D., English

Ernesto Sanz, B.A., M.A., M.A., Ph.D.,
Economics

Charles F. Carroll, A.B., A.M., Ph.D.,
History

Mario Aste, A.B., A.M., Ph.D., Languages

Kenneth M. Levasseur, B.A., M.S., Ph.D.,
Mathematical Sciences

Robert Innis, A.B., S.T.B., A.M., Ph.D.,
Philosophy

James J. Egan, B.A., M.S., Ph.D., Physics
and Applied Physics

William A. Lindeke, A.B., M.A., Ph.D.,
Political Science

Charlotte Mandell, B.A., M.A., Ph.D.,
Psychology

John C. Wooding, B.Sc., M.A., Ph.D.,
Regional Economic and Social Develop.

Carol Brown, B.S., M.S., Ph.D., Sociology

Professors Emeriti

Adolph Baker, Professor Emeritus of
Physics; B.A., M.S., City College of New
York; B.M.E., Polytechnic Institute of
Brooklyn; M.S., New York University;
Ph.D., Brandeis University

COLLEGE OF ARTS AND SCIENCES

Faculty

William W. Bannister, Professor Emeritus of Chemistry; B.S., Ph.D., Purdue University

Leon E. Beghian, Professor Emeritus of Physics; B.A., Ph.D., Oxford University

Alexandre Blumstein, Professor Emeritus of Chemistry; B.S. Sorbonne, Engineer, Institute de Chimie de Toulouse; Ph.D., University of Strasbourg

Rita Blumstein, Professor Emerita of Chemistry; B.S., Sorbonne; M.S., University of Strasbourg; Ph.D., University of Delaware

William C. Burto, Professor Emeritus of English; A.B., Colgate University; A.M., Ph.D., Harvard University

George L. Carr, Professor Emeritus of Physics; B.S., M.Ed., W. Maryland College; Ph.D., Cornell University

Robert M. Coleman, Professor Emeritus of Biological Sciences; B.S., Bates College; M.S., University of New Hampshire; Ph.D., University of Notre Dame

Pasquale Condo, Associate Professor Emeritus of Mathematical Sciences; B.S., Purdue University; M.S., Lowell Technological Institute

Robert C. Curtis, Professor Emeritus of Environmental, Earth, and Atmospheric Sciences; A.B., Williams College; Ph.D., Pennsylvania State University

Joyce Denning, Associate Professor Emerita of Political Science; A.B., Tufts University; A.M., Duke University

Richard L. Derry, Associate Professor Emeritus of History; A.B., Holy Cross College; A.M., Boston College
M. Brendan Fleming, Professor Emeritus of Mathematical Sciences; B.S., M.S., Boston College

Robert J. Foy, Professor Emeritus of English; B.S., Plymouth State College of U.N.H.; M.A., Ed.S., George Peabody College; Ed.M., Ed.D., Harvard University

Arthur Friedman, Professor Emeritus of English; A.B., City College of New York, A.M., Boston University

F. Raymond Hardy, Professor Emeritus of Physics; B.S., M.S., Lowell Technological Institute

Jesse Y. Harris, Professor Emeritus of Physics (Radiological Sciences); B.S., M.S., Ph.D., Rutgers University

Don B. Hilton, Associate Professor Emeritus of Chemistry; A.B., Boston University; M.S., Northeastern University; Ph.D., University of Maine

Ernest P. James, Professor Emeritus of Chemistry; B.T.C., M.S., Lowell Textile Institute

Ethel N. Kamien, Professor Emerita of Biological Sciences; B.A., Brooklyn College; M.S., Ph.D., University of Wisconsin

Shirley Kolack, Professor Emerita of Sociology; B.S., A.M., Ph.D., Boston University

Anthony Liuzzi, Professor Emeritus of Physics; B.S., Rensselaer Polytechnic Institute; M.S., Ph.D., New York University

John F. Lyon, Professor Emeritus of Biological Sciences; B.S., M.S., University of New Hampshire

Thomas V. Marcella, Professor Emeritus of Physics; B.S., Lowell Technological Institute; M.S., Northeastern University; Ph.D., Boston College

Suresh Mathur, Professor Emeritus of Physics; B.S., M.S., University of Lucknow, India; Ph.D., University of Texas

Walter R. Mellen, Professor Emeritus of Physics; S.B., Massachusetts Institute of Technology; M.S., Lowell Technological Institute

Arthur I. Miller, Professor Emeritus of Philosophy; B.S., City College of New York; Ph.D., Massachusetts Institute of Technology

Gerard W. O'Connor, Professor Emeritus of English; A.B., Harvard University; A.M., Ph.D., Boston University

Gerard A. Paquette, Professor Emeritus of Mathematical Sciences, B.A., LaMennais College; M.A., Boston College; Ph.D., The Pennsylvania State University

Judith Pastore, Professor Emerita of English; A.B., Rutgers University; A.M., Radcliffe College; Ph.D., Harvard University

James B. Pierce, Professor Emeritus of Chemistry; B.S. Theil College; M.S., Ph.D., Case Institute Technology

Nicholas J. Rencricca, Professor Emeritus of Biological Sciences; B.S., St. Francis College; M.S., St. Johns University; Ph.D., Boston College

Paul J. Ring, Professor Emeritus of Physics (Radiological Sciences); B.S., Boston College; M.S., Rensselaer Polytechnic Institute; Ph.D., Brown University

Harry Rubinstein, Professor Emeritus of Chemistry; B.S., Brooklyn College; Ph.D., Purdue University

Joseph C. Salamone, Professor Emeritus of Chemistry; B.S., Hofstra University; Ph.D., Polytechnic Institute of Brooklyn

Bernard Shapiro, Professor Emeritus of Mathematical Sciences; B.S., Lowell Technological Institute; S.M., Massachusetts Institute of Technology

Eric Sheldon, Professor Emeritus of Physics; B.Sc., B. Sc., Ph.D., D.Sc., University of London

Prentiss Shepherd, Jr., Professor Emeritus of Biological Sciences; A.B., A.M., Harvard University

Kenneth W. Skrable, Professor Emeritus of Physics (Radiological Sciences); B.S., Moravian College; M.S., Vanderbilt University; Ph.D., Rutgers University

Malcolm K. Smith, Professor Emeritus of Physics; B.S., Haverford College; M.A. Columbia University

John Staulo, Associate Professor Emeritus of Languages; A.B., Boston College; M.A., Middlebury College; Ph.D., Catholic University of America

Wen Tang, Professor Emeritus of Environmental, Earth, and Atmospheric Sciences; B.S., Nat'l Central University (China); M.S., Ph.D., New York University

Virginia S. Taylor, Professor Emerita of Mathematical Sciences; B.S., Syracuse University; M.A., Western Michigan University; Ph.D., Boston College

Roger Wiehe, Professor Emeritus of English; B.A., Yale University; M.A., University of Illinois; Ph.D., Columbia University

Faculty

Joyce W. Williams, Associate Professor Emeritus of Mathematical Sciences; B.A., University of Minnesota; M.S., Ph.D., University of Illinois

Francis Worrell, Professor Emeritus of Physics; B.S., University of Michigan; M.S., Ph.D., University of Pittsburgh

Charles E. Zivavras, Professor Emeritus of English; B.S., M.A., Boston University

Faculty

Albert Altman, Professor of Physics; B.S., Brooklyn College; M.S., Ph.D., University of Maryland

Mario Aste, Professor of Languages; A.B., University of Turin; A.M., Ph.D., Catholic University

Harald C. Bakken, Professor of History; A.B., University of Minnesota; Ph.D., Harvard University

Eugene F. Barry, Professor of Chemistry; B.S., Villanova University; Ph.D., University of Rhode Island

Christos J. Bantas, Professor of History; A.B., Ed.M., Boston University; A.M., Ph.D., Tufts University

Dean J. Bergeron, Professor of Regional Economic and Social Development; A.B., St. Michael's College; A.M., Villanova University

William R. Berkowitz, Associate Professor of Psychology; A.B., Cornell University; Ph.D., Stanford University

Shimshon Berkovits, Professor of Mathematical Sciences; S.B., Massachusetts Institute of Technology; M.S., University of Chicago; Ph.D., Northeastern University

Donald R. Berry, Associate Professor of English; A.B., M.A., Baylor University

Mary Blewett, Professor of History; A.B., A.M., Ph.D., University of Missouri

Peter Blewett, Professor of History; A.B., Northeastern University; A.M., Ph.D., Boston College

Meg Bond, Associate Professor of Psychology; B.A., Stanford University; M.A., Ph.D., University of Oregon

Susan J. Braunhut, Associate Professor of Biological Sciences; B.A., Kent State University; M.A., University of Hartford; M.A., M.Phil., Ph.D., Columbia University

Ronald I. Brent, Associate Professor of Mathematical Sciences; B.S. State University of New York at Binghamton; M.S., Ph.D., Rensselaer Polytechnic Institute

Carol Brown, Associate Professor of Sociology; A.B., M.A., Bucknell University; Ph.D., Columbia University

John Buford, Associate Professor of Computer Science; B.S., M.S., Massachusetts Institute of Technology; Ph.D., Technical University of Graz

Janet Burke, Professor of Psychology; B.S., M.Ed., Ph.D., Boston College

William J. Burke, Professor of Legal Studies; B.A., University of Massachusetts; M.Ed., Boston State College; J.D., Suffolk University

Eva Buzawa, Professor of Criminal Justice; A.B., University of Rochester; M.S., Ph.D., Michigan State University

Charles L. Byrne, Professor of Mathematical Sciences; B.A., Georgetown University; M.A., Ph.D., University of Pittsburgh

James M. Byrne, Professor of Criminal Justice; A.B., University of Massachusetts; M.A., Ph.D., Rutgers University

James Canning, Associate Professor of Computer Science; A.B. University of Maine; M.S., Iowa State University; Ph.D., Virginia Polytechnic Institute

Joan Cannon, Associate Professor of Psychology; A.B., St. Mary's College; M.Ed., Boston University; Ed.D., Clark University

Charles F. Carroll, Professor of History; A.B., A.M., Boston College; Ph.D., Brown University

Michael J. Carter, Associate Professor of Economics; B.A., Yale University; M.A., Ph.D., Stanford University

Albert M. Cederlund, Professor of Economics; A.B., Clark University; M.S., Columbia University; Ph.D., Clark University

George E. Chabot, Jr., Professor of Physics; A.B., Harvard University; M.S., Harvard School of Public Health; Ph.D., University of Lowell

Liana De Girolami Cheney, Professor of Art History; B.S., A.M., University of Miami; Ph.D., Boston University

Levon Chorbajian, Professor of Sociology; A.B., Temple University; A.M., University of Michigan; Ph.D., Brandeis University

Partha Chowdhury, Associate Professor of Physics; B.Sc., Indian Institute of Technology; M.S., Ph.D., State University of New York, Stonybrook

Frank P. Colby, Jr., Associate Professor of Environmental, Earth, and Atmospheric Sciences; B.S., University of Michigan; M.S., Ph.D., Massachusetts Institute of Technology

Andrea Corbett, Associate Professor of English; A.B., University of New Hampshire; M.A., Vanderbilt University

Thomas M. Costello, Professor of Computer Science; B.S., Boston College; M.A., Ph.D., University of Maryland

Gus P. Couchell, Professor of Physics; B.S., M.S., N. Carolina State University; Ph.D., Columbia University

William Coughlin, Associate Professor of English; B.S., Lowell State College; A.M., Middlebury College; Ed.D., University of Massachusetts

Arthur T. Dabilis, Assistant Professor of English; A.B., Suffolk University; M.A., Northeastern University

Mitra Das, Professor of Sociology; A.B., A.M., University of Rajasthan; Ph.D., University of Massachusetts

Nancy DeLuca, Associate Professor of Chemistry; B.S., Queen's College of New York; M.S., Ph.D., Ohio State University

George C. Dery, Associate Professor of Economics; A.B., Merrimack College; M.A., Boston College

Alan W. Doerr, Professor of Mathematical Sciences; B.A., Marist College; M.A., Hunter College

David T. Eberiel, Professor of Biological Sciences; B.S., Bethany College; M.S., Tufts University; Ph.D., Boston College

COLLEGE OF ARTS AND SCIENCES*Faculty*

G. Nelson Eby, Professor of Environmental, Earth, and Atmospheric Sciences; A.B., M.S., Lehigh University; Ph.D., Boston University

James J. Egan, Professor of Physics; B.A., Thomas More College; M.S., Ph.D., University of Kentucky

Tara Elyssa, Assistant Professor of English; B.A., Hope College; M.A.Ed., Ed.D., Ball State University

Rudolf Faust, Professor of Chemistry; B.S., Ph.D., Eotvos Lorand University of Sciences (Budapest)

Robert Forrant, Assistant Professor of Regional Economic and Social Development; M.A., Northeastern University; Ph.D., University of Massachusetts Amherst

Jane Freimiller, Assistant Professor of Philosophy; B.A., Haverford College; M.A., Ph.D., Boston College

Clayton S. French, Jr., Associate Professor of Physics; B.S., Lowell Technological Institute; M.S., Ph.D., University of Lowell

Zoltan Fried, Professor of Physics; B.S., Brooklyn College; Ph.D., Brandeis University

Susan E. Gallagher, Assistant Professor of Political Science; B.A., Ramapo College of New Jersey; M.A., Ph.D., New School for Social Research

Robert R. Gamache, Associate Professor of Environmental, Earth, and Atmospheric Sciences; B.S., Southwestern Massachusetts University; M.S., Ph.D., University of Massachusetts at Amherst

Joseph Garreau, Professor of Languages; A.B., University of Poitiers; S.T.L., College Saint Albert de Louvain, A.M., Ph.D., Boston College

Jeffrey Gerson, Assistant Professor of Political Science; B.S., State University of New York College at Brockport; Ph.D., City University of New York

Dan S. Golomb, Associate Professor of Environmental, Earth, and Atmospheric Sciences; M.Sc., Sc.D., Hebrew University, Jerusalem

Enrique Gonzalez-Velasco, Professor of Mathematical Sciences; B.S., Ph.D., Polytechnic University of Madrid; Sc.M., Ph.D., Brown University

William D. Goodhue, Professor of Physics; B.S. Worcester Polytechnic Institute; M.A., University of Massachusetts Amherst; Ph.D., University of Massachusetts Lowell

Richard Z. Gore, Associate Professor of Environmental, Earth, and Atmospheric Sciences; B.S., City College of New York; M.S., Boston College; Ph.D., Boston University

James Graham-Eagle, Associate Professor of Mathematical Sciences; B.S., M.S., Victoria University; Ph.D., Oxford University

Georges G. Grinstein, Professor of Computer Science; B.S., City College of New York; M.S., New York University; Ph.D., University of Rochester

Laurence F. Gross, Associate Professor of Regional Economic and Social Development; B.A., Wesleyan University; Ph.D., Brown University

Richard A. Gross, Professor of Chemistry; B.S., State University of New York at Albany; Ph.D., Polytechnic University

Raymond D. Gumb, Professor of Computer Science; B.S., Massachusetts Institute of Technology; M.A., Emory University; Ph.D., Lehigh University

Garth Hall, Assistant Professor of Biological Sciences; B.S., McGill University; Ph.D., Yale University

Padmanabh Harihar, Professor of Physics; B.S., R. Ruia College (India); M.S., Wilson College (India); Ph.D., Columbia University

Jesse M. Heines, Associate Professor of Computer Science; B.S., Massachusetts Institute of Technology; M.S., University of Maine; Ed.D., Boston University

Jon C. Hellstedt, Professor of Psychology; A.B., Augustana College; B.D., Yale University; Ph.D., Boston University

J. Heli Hernandez, Professor of Languages; A.B., University of Javeriana (Bogota); A.M., Ph.D., Catholic University

William R. Hersey, Professor of English; B.S., Lowell State College; M.A., Boston College; Ph.D., University of New Hampshire

Jerome L. Hojnacki, Professor of Biological Sciences; Dean of the Graduate School, B.S., Southern Connecticut State College; M.S., University of Bridgeport; Ph.D., University of New Hampshire; M.H.A., Clark University

Hilary Holladay, Assistant Professor of English; B.A., University of Virginia; M.A., College of William and Mary; Ph.D., University of North Carolina at Chapel Hill

Gerald T. Hotaling, Professor of Criminal Justice; B.A., University of Delaware; M.A., Ph.D., University of New Hampshire

Kathleen D. Hulbert, Professor of Psychology; A.B., Northwestern University; Ed.M., Ed.D., Boston University; C.A.G.S., University of New Hampshire

Ann Marie Hurley, Associate Professor of Mathematical Sciences; A.B., Emmanuel College; M.S., University of Lowell

Robert Innis, Professor of Philosophy; A.B., St. Mary's College; S.T.B., Gregorian University; A.M., Ph.D., Fordham University

Martin Isaks, Associate Professor of Chemistry; B.S., Purdue University; M.S., Iowa State University; Ph.D., University of Cincinnati

Stanley C. Israel, Professor of Chemistry; B.S., Parsons College; Ph.D., Lowell Technological Institute

Edwin Jahngen, Jr., Professor of Chemistry; B.S., Bates College; Ph.D., University of Vermont

Lee K. Jones, Professor of Mathematical Sciences; B.S., Tufts University; M.S., Ph.D., Stanford University

Michael Jones, Associate Professor of Legal Studies, B.A., Denison University; M.B.A., University of Pennsylvania; J.D., University of Miami

Jeannie Sargent Judge, Assistant Professor of English, B.A., Lowell State College; M.A., Ph.D., Boston University

Robert Kachur, Assistant Professor of English, B.A., University of Virginia; M.A., Ph.D., University of Wisconsin

Gerald Kaiser, Professor of Mathematical Sciences; B.S., Case Institute of Technology; M.S., Ph.D., University of Wisconsin; Ph.D., University of Toronto

Lloyd C. Kannenberg, Professor of Physics; S.B., Massachusetts Institute of Technology; M.S., University of Florida; Ph.D., Northeastern University

Alan Kaplan, Associate Professor of Mathematical Sciences; B.S., University of Massachusetts; M.S., Ph.D., Syracuse University

Aram S. Karakashian, Professor of Physics; B.A., M.A., Temple University; Ph.D., University of Maryland

Russell R. Karl, Associate Professor of Legal Studies; B.S., Bryant College; M.S., Suffolk University; J.D., Suffolk Law School

Renée Kasinsky, Professor of Criminal Justice; A.B., M.A., Ph.D., University of California at Berkeley

Gunter H. R. Kegel, Professor of Physics; B.Ph., University of Brazil; Ph.D., Massachusetts Institute of Technology

Judith A. Kelley, Professor of Chemistry; B.A., Emmanuel College; M.S., Lowell Technological Institute; M.Ed., Ed.D., Northeastern University

Byung G. Kim, Associate Professor of Computer Science; B.S., Seoul National University; M.S., University of Massachusetts; Ph.D., University of Massachusetts

Nancy Kleniewski, Professor of Sociology; Dean of Humanities and Social Sciences; A.B., Emmanuel College; M.A., Ph.D., Temple University

Albert D. Kowalak, Professor of Chemistry; B.S., College of William and Mary; M.S., Ph.D., Virginia Polytechnic Institute

Mary D. Kramer, Professor of English; A.B., University of Wisconsin; A.M., Ph.D., University of Kansas

Patrick D. Krolak, Professor of Computer Science; B.S., University of Chicago; M.A., D.Sc., Washington University

Thomas G. Kudzma, Associate Professor of Mathematical Sciences; B.S., Massachusetts Institute of Technology; A.M., Harvard University

Jayant Kumar, Professor of Physics; B.S., M.S., Indian Institute of Technology; Ph.D., Rutgers University

Sarah Kuhn, Assistant Professor of Regional Economic and Social Development; B.A., Harvard College; Ph.D., Massachusetts Institute of Technology

Robert Kunzendorf, Professor of Psychology; A.B., Yale University; M.A., Ph.D., University of Virginia

Supriya Lahiri, Associate Professor of Economics; B.A., Presidency College (India); M.A., Ph.D., University of Delhi

Philip S. Lamprey, Professor of Chemistry; B.S., Lowell Technological Institute; Ph.D., University of New Hampshire

David Landrigan, Associate Professor of Psychology; B.S., Tufts University; M.A., Ph.D., University of New Hampshire

David Larsen, Professor of Physics; S.B., Ph.D., Massachusetts Institute of Technology

William H. Lazonick, Professor of Regional Economic and Social Development; B.Com., University of Toronto; M.Sc., London School of Economics; Ph.D., Harvard University

Robert J. Lechner, Professor of Computer Science; B.S., M.S., Carnegie-Mellon University; Ph.D., Harvard University

Siu-Lam Lee, Associate Professor of Biological Sciences; B.S., Chung Chi College (Hong Kong); M.A., Oberlin College; Ph.D., Cornell University

Kenneth M. Levasseur, Professor of Mathematical Sciences; B.A., St. Anselm College; M.S., Ph.D., University of Rhode Island

Haim Levkowitz, Associate Professor of Computer Science; B.A. University of Haifa; M.S.E., Ph.D., University of Pennsylvania

Clifford L. Lewis, Professor of English; A.B., Union College; A.M., State University of New York at Buffalo; Ph.D., University of Texas

Frederick P. Lewis, Professor of Political Science; A.B., Columbia University; J.D., Harvard University; Ph.D., Tufts University

K. P. Li, Associate Professor of Chemistry; B.S., M.S., Taiwan National University; M.S., Ph.D., University of Illinois

Jonathan J. Liebowitz, Professor of History; A.B., Columbia University; M.A., Ph.D., University of California at Berkeley

Alan Lincoln, Professor of Criminal Justice; B.S., Michigan State; M.S., M.A., Ph.D., University of Massachusetts

William A. Lindeke, Professor of Political Science; A.B., M.A., San Diego State College; Ph.D., Claremont Graduate School

Joseph W. Lipchitz, Professor of Criminal Justice; A.B., M.A., University of Massachusetts; Ph.D., Case Western Reserve University

Irving Lipschitz, Associate Professor of Chemistry; B.A., M.S., New York University; Ph.D., Virginia Polytechnic Institute

George W. Luter, Associate Professor of History; B.S., A.M., Xavier University

Robert D. Lynch, Professor of Biological Sciences; A.B., Northeastern University; M.S., D.Sc., Harvard University

Thomas G. Macbeth, Professor of Economics; A.B., Cornell University; M.A., Ph.D., University of Southern California

John D. MacDougall, Professor of Regional Economic and Social Development; B.A., M.A., Oxford University; Ph.D., Harvard University

Yuly Makovoz, Professor of Mathematical Sciences; M.S. University of Tchernovtsy; Ph.D., Urals University

John C. Mallett, Professor of Biological Sciences; B.S., College of the Holy Cross; M.S., Ph.D., University of Rhode Island

Charlotte Mandell, Professor of Psychology; A.B., Brooklyn College; M.A., Ph.D., Columbia University

Kenneth A. Marx, Professor of Chemistry; B.S., California State University at San Diego; Ph.D., University of California at Berkeley

William Mass, Associate Professor of Regional Economic and Social Development; B.G.S., University of Michigan; Ph.D., Boston College; M.P.H., Harvard University

Donald J. Mattheisen, Professor of History; A.B., A.M., Ph.D., University of Minnesota

COLLEGE OF ARTS AND SCIENCES*Faculty*

Allyssa McCabe, Associate Professor of Psychology; A.B., Oberlin College; M.A., Ph.D., University of Virginia

John M. McCaffrey, Associate Professor of English; A.B., Suffolk University; A.M., Tufts University

Arlene McCormack, Professor of Regional Economic and Social Development; A.B., M.A., Ph.D., Boston University

Melisenda McDonald, Professor of Chemistry; A.B., Dowling College; M.A., Ph.D., State University of New York at Buffalo

Carol C. McDonough, Professor of Economics; B.A., Marymount Manhattan College; M.A., Ph.D., Boston College

Martha McGowan, Professor of English; A.B., Brandeis University; A.M., Boston College; Ph.D., Boston University

Roger D. McLeod, Associate Professor of Physics; B.A., Bowdoin College; M.S., Lowell Technological Institute

R. Eugene Mellican, Professor of Philosophy; A.B., M.A., Ph.D., Loyola University

Barbara Langell Miliaras, Professor of English; A.B., Ed.M., Boston University; Ph.D., Tufts University

Marlowe Miller, Assistant Professor of English; B.A., Loyola Marymount University; C.Phil., Ph.D., University of California at San Diego

Avalon N. Minton, Associate Professor of Political Science; B.A., Wake Forest University; Ph.D. (Cand.) Brown University

Rida M. Mirie, Associate Professor of Mathematical Sciences; B.Sc., American Institute of Beirut (Lebanon); M.Sc., Ph.D., Brown University

Arthur Mittler, Professor of Physics; B.A., Drew University; M.S., Ph.D., University of Kentucky

William Moloney, Jr., Associate Professor of Computer Science; B.S., M.S., Lowell Technological Institute

Philip I. Moss, Associate Professor of Regional Economic and Social Development; B.A., John Hopkins University; Ph.D., Massachusetts Institute of Technology

Guntram B. Mueller, Associate Professor of Mathematical Sciences; B.Sc., Loyola College (Montreal); M.S., Ph.D., Notre Dame University

Anne Mulvey, Professor of Psychology; A.B., Barat College; M.A., Hunter College; Ph.D., City University of New York

Charles Nikitopoulos, Associate Professor of Psychology; A.B., Suffolk University; A.M., New School for Social Research; Ph.D., Boston College

Arnold L. O'Brien, Professor of Environmental, Earth, and Atmospheric Sciences; A.B., M.S., Syracuse University; Ph.D., Boston University

Alexander A. Olsen, Associate Professor of Mathematical Sciences; B.S. Lowell Technological Institute; M.S., Northeastern University; Ph.D., Boston College

Thaddeus V. Osmolski, Professor of Biological Sciences; B.S., University of Rhode Island; Ph.D., Brown University

Giampiero Pecelli, Professor of Computer Science; B.A., E. Washington State College; Ph.D., Johns Hopkins University

Melissa M. Pennell, Associate Professor of English; A.B., College of William and Mary; A.M., Ph.D., Brown University

Stephen A. Pennell, Professor of Mathematical Sciences; B.S., Rensselaer Polytechnic Institute; Sc.M., Ph.D., Brown University

Carolyn Petrosino, Assistant Professor of Criminal Justice; B.S., Howard University; M.S.W., Ph.D., Rutgers University

Hai B. Pho, Professor of Political Science; A.B., Boston College; A.M., Rutgers University; A.M., Ph.D., Boston University

Ronald Pickett, Professor of Psychology; A.B., Dartmouth; M.A., Ph.D., University of Michigan

Vidhu Prasad, Professor of Mathematical Sciences; B.S., M.S., McGill University; Ph.D., Bryn Mawr College

David J. Pullen, Professor of Physics; B.Sc., London University; D. Phil., Oxford University

Jean L. Pyle, Professor of Regional Economic and Social Development; B.A., Bucknell University; M.A., University of Michigan; Ph.D., University of Massachusetts

Shelley L. Rasmussen, Associate Professor of Mathematical Sciences; B.S., M.A., Central Michigan University; M.S., Ph.D., University of Michigan

Bodo W. Reinisch, Professor of Environmental, Earth, and Atmospheric Sciences; M.S., Freiburg, Ph.D., University of Lowell

Ezequiel R. Rivera, Professor of Biological Sciences; B.S., Sul Ross State University; M.S., Purdue University; Ph.D., University of Texas

William H. Roberts, Professor of English; A.B., B.S., A.M., Ph.D., Ohio State University

Louis F. Rossi, Assistant Professor of Mathematical Sciences; B.S., Harvey Mudd College, M.A. University of California, Berkeley, Ph.D., University of Arizona

Mary Beth Ruskai, Professor of Mathematical Sciences; B.S., Notre Dame College; M.S., Ph.D., University of Wisconsin

Charles J. Ryan, Associate Professor of English; A.B., University of Connecticut; M.A., University of Massachusetts

David Ryan, Associate Professor of Chemistry; B.S., Le Moyne College; Ph.D., University of New Hampshire

Alexander Sachs, Associate Professor of Physics; B.S., Northwestern University; Ph.D., University of New Hampshire

Herlinda Ch. Saitz, Professor of Languages; Licenciatura, University of Panama; Diplomas de Especializacion, Semanario Andres Bello (Columbia); Ph.D., Boston University

Alexander Samarov, Professor of Mathematical Sciences; B.S., M.S., Moscow State University; Cand., Academy of Sciences (Moscow)

Daniel Sandman, Professor of Chemistry; B.S., Drexel University; M.A., Ph.D., Princeton University

Ernesto Sanz, Professor of Economics; B.A., Loyola University (Spain); M.A., Kamakura Language College (Japan); M.A., Sophia University (Japan); Ph.D., Boston College

Samuel P. Sawan, Professor of Chemistry; B.S., Ph.D., University of Akron

Walter A. Schier, Professor of Physics; B.S., St. Procopius College; Ph.D., University of Notre Dame

Kunnat J. Sebastian, Professor of Physics; B.S., St. Berchmans College; M.S., University College (India); Ph.D., University of Maryland

Gloria C. Seeman, Associate Professor of Psychology; A.B., City College of New York; M.S., Ph.D., Syracuse University

Ashot A. Shahinian, Associate Professor of Mathematical Sciences; M.S., State University of Yerevan (Armenia); Ph.D., Steklov Mathematical Institute (Moscow)

John J. Shea, Associate Professor of History; A.B., Harvard College; A.M., Creighton University; Ph.D., Boston University

Thomas B. Shea, Associate Professor of Biological Sciences; B.A., M.S., University of Massachusetts Boston; Ph.D., Northeastern University

John C. Sieg, Jr., Associate Professor of Computer Science; A.B., Dartmouth College; M.S., University of Lowell; Ph.D., Boston University

Larry J. Siegel, Professor of Criminal Justice; B.A., City College of New York; M.A., Ph.D., State University of New York at Albany

Richard A. Siegel, Associate Professor of Psychology; A.B., Harvard College; M.S., Yale University; Ph.D., Boston University

Balbir S. Sihag, Professor of Economics; B.A., Dayanand College (India); M.A., Punjab University (India); Ph.D., Massachusetts Institute of Technology

Linda Silka, Professor of Regional Economic and Social Development; B.S., Oklahoma University; M.A., Ph.D., University of Kansas

Ilze Skare, Associate Professor of Biological Sciences; B.A., University of Connecticut; Ph.D., Duke University

P. Christopher Smith, Professor of Philosophy; A.B., A.M., Columbia University; Ph.D., University of Heidelberg

Stuart Smith, Professor of Computer Science; B.A., Rutgers University; M.F.A., Brandeis University; Ed.D., University of Massachusetts

Paul E. Snoonian, Associate Professor of Economics; B.S., M.B.A., Northeastern University; M.A., Ph.D., Michigan State University

Frederick Sperounis, Associate Professor of Sociology; Vice Chancellor for University Relations, B.S.Ed., Salem State College; M.A., Ph.D., Brandeis University

Stanley L. Spiegel, Associate Professor of Mathematical Sciences; B.S., New York University; A.M., Ph.D., Harvard University

Charles A. Steele, Jr., Associate Professor of Computer Science; A.B., M.A., Boston College; M.S.E.E., Northeastern University

Robert A. Stein, Professor of English; A.B., Clark University; A.M., Ph.D., Brandeis University

Marvin E. Stick, Associate Professor of Mathematical Sciences; B.S., Boston College; M.A., Boston University; Ph.D., Boston College

Richard W. Stimets, Professor of Physics; B.S., Ph.D., Massachusetts Institute of Technology

Robert H. Tamarin, Professor of Biological Sciences; Dean of Sciences; B.S., Brooklyn College of the City University of New York; Ph.D., Indiana University

Ruth E. Tanner, Professor of Chemistry; B.S., Purdue University; Ph.D., University of Cincinnati

Ye-Yung Teng, Professor of Physics; B.S., National Taiwan University; M.S., Ph.D., University of Maryland

Francesca Tillona, Associate Professor of English; A.B., Brooklyn College; A.M., Ph.D., Boston University

Chris Tilly, Associate Professor of Regional Economic and Social Development, B.A., Harvard College; Ph.D., Massachusetts Institute of Technology

Sukant K. Tripathy, Professor of Chemistry; B.S., M.S., Indian Institute of Technology (Kharagpur); Ph.D., Case Western Reserve University

Robert B. Wagner, Associate Professor of Philosophy; Provost; B.S., Ohio State University; A.M., Kent State University; Ed.D., Harvard University

Jerry Waldman, Professor of Physics; B.A., M.A., Columbia University; Ph.D., Massachusetts Institute of Technology

Francis R. Walsh, Professor of History; B.S., M.A., Ph.D., Boston University

Mary Roth Walsh, Professor of Psychology; B.S., Mount Mary College; M.S., Cornell University; Ph.D., Boston University

Alice Walters, Assistant Professor of History; B.S. University of Washington, M.A., Ph.D., University of California at Berkeley

Joseph W. Waterman, Associate Professor of Psychology; B.S., University of Vermont; M.B.A., Boston University; P.Ed., University of Connecticut

Arthur C. Watterson, Jr., Professor of Chemistry; B.S., Geneva College; Ph.D., Brown University

I. Jacob Weinberg, Professor of Mathematical Sciences; B.S., Yeshiva University; M.S., Ph.D., Massachusetts Institute of Technology

Robert J. Whelan, Associate Professor of Languages, A.B., Boston College; M.A., Catholic University of America

Marian Williams, Assistant Professor of Computer Science; A.B., Radcliffe College; M.Ed., Boston University; M.S., University of Lowell; D.Sc., University of Massachusetts Lowell

Martin Wilner, Professor of Physics; B.S., Rensselaer Polytechnic Institute, M.S., Yale University; Ph.D., Massachusetts Institute of Technology

Richard E. Winslow, Assistant Professor of Mathematical Sciences; B.A., Columbia University; M.A., Ph.D., Brandeis University

Chuen Wong, Associate Professor of Physics; Dip. Sci., Chung Chi College (Hong Kong); Ph.D., Case Institute of Technology

COLLEGE OF ARTS AND SCIENCES

Faculty

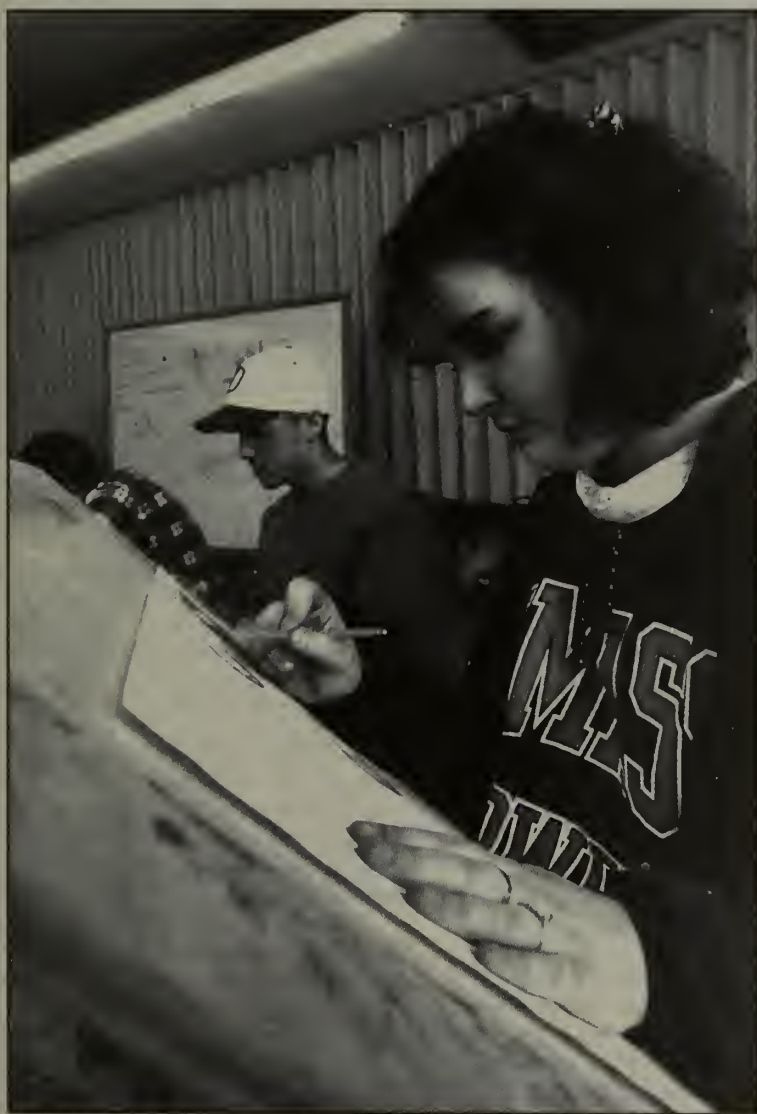
John C. Wooding, Associate Professor of
Regional Economic and Social
Development; B.Sc., London School of
Economics and Political Science; M.A.,
Cornell University; Ph.D., Brandeis
University

Yong Q. Yin, Professor of Mathematical
Sciences; B.S., Tsing Hua University
(Beijing); Ph.D., University of Pittsburgh

Joseph Zaitchik, Professor of English; A.B.,
Suffolk University; A.M., Ph.D., Boston
University

James B. Francis

College of Engineering



Engineering is a profession which is concerned with the application of scientific knowledge to the development of technology for the improvement of society. It is involved in the identification of societal needs, the definition of technological problems which address these needs and the creative solutions to these problems in ways that are sensitive to the constraints demanded by society.

The College of Engineering recognizes that the engineering needs of society are complex and varied as are the diverse interests, motivations, competencies, and backgrounds of its students. Therefore, it has developed a broad spectrum of programs to serve the needs of the student society and the high technology sector of the Massachusetts economy. The emphasis within each engineering program is on technical rigor, utilizing the latest advances in computer technology for the solution of engineering problems. At the same time, each program is characterized by a curriculum that is broad enough to produce engineers who are qualified to meet contemporary demands.

The College has 18 active chapters of professional engineering societies, including the National Society of Black Engineers and the Society of Women Engineers. In addition, it has a Chapter of Tau Beta Pi, the national engineering honor society. Student participation in these societies is encouraged.

A review course is offered in cooperation with the Massachusetts Society of Professional Engineers for students planning to take the Fundamentals of Engineering (F.E.) examination. The College serves twice a year as host for the examination which is a requirement for registration as a professional engineer. Students are strongly urged to take the F.E. examination at the appropriate time.

Krishna Vedula, Dean

Gil Brown, Asst. to the Dean

Walter Kuklinski, Asst. to the Dean

COLLEGE OF ENGINEERING

College Policies and Requirements

Objectives of the College of Engineering

The College of Engineering seeks to prepare men and women for their entrance into the engineering profession in anticipation of their becoming leaders in industry, government, and education. Programs in the College of Engineering have been structured to permit students the option of entering the practice of engineering immediately after attaining an undergraduate degree or to delay entrance to the profession until they have attained a graduate degree.

Programs are available in several engineering disciplines to accommodate varied interests. In addition, within each discipline students may prepare for various careers such as research, development, design, production, construction, teaching, and management. A faculty advisor is assigned to each student to provide experienced guidance in selecting programs and courses and in career planning.

Each student is encouraged to develop his or her full potential as an engineer with a high degree of awareness of the technological needs of society, the nation, and particularly those of Massachusetts industry, government and educational institutions.

The College stresses professional needs by continuously updating courses and options in the standard engineering and selected specialty programs. The departments use all available resources to advance the level of excellence of their programs. Standards are monitored by the Engineering Accreditation Commission and the Technology Accreditation Committee of the Accreditation Board of Engineering and Technology (ABET). Departments adhere to the standards of the National Society of Professional Engineers. The college also follows the careers of successful graduates, and solicits their views on making programs more relevant and effective.

In each discipline, the College of Engineering offers graduate research programs which not only serve as a source of updating the undergraduate course offerings, but also ensure that faculty are on the cutting edge of their particular disciplines. These programs advance the general level of information and knowledge that is so essential in fast-moving technological

fields, while providing the highly specialized research required by industry. By functioning as an educational resource to the engineering profession and industry of the Commonwealth through instruction, consulting services, and research, the College of Engineering at the University of Massachusetts Lowell provides its students with an ever-current view of the working world for which they must prepare.

The College offers a Division of Continuing Education program in the evening leading to associate and baccalaureate degrees in engineering technology. The Division of Continuing Education provides men and women an opportunity at the associate, undergraduate and graduate degree levels to further their preparation for careers.

College Organization and Governance

The College of Engineering is organized into seven departments: Chemical and Nuclear Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, Plastics Engineering, Work Environment and Engineering Technology. While focusing on their respective special fields of study, the departments share many common interests in engineering, science, the humanities, and social sciences. Though students must declare a major in a specific program, they take courses in other departments both within and outside of the College of Engineering.

The College is administered by a dean. As the chief academic and executive officer, it is the Dean's responsibility to formulate goals and objectives for the College within the context of the University mission and to implement programs of high academic quality to attain these goals. The Dean is assisted by two senior faculty members. The Engineering Academic Council of the College and the Industrial Advisory Council in each of the professional areas support the College and the departments in monitoring academic standards and in ensuring the current relevancy of the curriculum.

Each department is administered by a department head. Each is responsible for developing its own course offerings. The engineering faculty as a whole is responsible for all academic policies of the College.

The ability to communicate ideas clearly, concisely, and accurately is vital to our graduates' success as practicing engineers. The UMass Lowell Engineering faculty expects them to compete both technically and professionally with those from the best engineering schools in America. Mathematical skills and communication skills are required for a successful engineering education and career. All freshman engineering students are evaluated to determine the proper starting points for mathematics and english. Placement is determined by an evaluation of a special College Board Test taken before school starts, their SAT scores, rank in high school class, and mathematics courses taken in high school. This allows for an initial placement into a suitable calculus sequence which will increase their chance for success in the engineering curriculum.

The Centers for Learning and Academic Support Services (CLASS) support the College of Engineering's retention and academic programs by providing a comprehensive network of academic services that enable both faculty and students to excel in teaching and learning. These include peer tutoring, computer assisted learning, advising, early academic evaluations, and workshops on time management, note taking and textbook reading.

In addition, Project Restart is a program for freshman who were suspended after their first semester at UMass Lowell. It allows the students to start over while learning the skills that are necessary to be a better student.

Center for Women in Engineering and Science

The Center for Women in Engineering and Science provides a supportive and inclusive environment for women pursuing careers in engineering and science. It provides pathways to resources and services available on campus as well as in government and the private sector. The Center will also provide opportunities to network with industry and to help prepare women for entry into academic and industrial careers. The Center creates an environment for women students to support each other and to network among themselves.

Engineering Academic Council

The Engineering Academic Council, consisting of the Dean, the two faculty assistants to the Dean and department heads representing each department, is responsible for enforcing academic standards of the College and establishing and enforcing disciplinary procedures. This committee also serves as a review body for suspended students seeking readmission to the College. Members of the committee are:

William Moeller, Civil Engineering, Chairperson

Alfred Donatelli, Chemical and Nuclear Engineering, Chairperson

Struan Robertson, Mechanical Engineering, Chairperson

Donald S. Pottle, Engineering Technology, Chairperson

Michael Fiddy, Electrical Engineering, Chairperson

Robert E. Nunn, Plastics Engineering, Chairperson

David Wegman, Work Environment, Chairperson

Krishna Vedula, Dean

Gilbert Brown, Asst. to the Dean

Walter Kuklinski, Asst. to the Dean

Industrial Advisory Councils

Each engineering program is supported by an Industrial Advisory Council composed of industrial leaders. This Industrial Advisory Council supports the College and the departments in formulating new curricula and in keeping programs up-to-date with rapidly advancing high technology. These councils serve to promote a high degree of interaction between the College and the manufacturing industry and regional economy which it primarily serves. In addition, the College has an Industrial Advisory Council that considers broader issues relative to the continued development of all the engineering undergraduate and graduate programs in keeping with the University's mission.

Undergraduate Degree Programs

The College of Engineering offers four and five year undergraduate programs leading to the degree of Bachelor of Science in Engineering and the Associate and Bachelor of Science in Engineering Technology (in evening part-time programs), five-year dual-degree programs with the College of Arts and Sciences leading to a Bachelor of Science degree in Engineering and a Bachelor of Arts, and five-year programs leading to both Bachelor of Science in Engineering and Master of Science in Engineering.

The degree of Bachelor of Science in Engineering is offered in the following fields: Chemical Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering and Plastics Engineering. Course requirements for engineering degrees have been determined by specific professional objectives and are subject to the recommendations of the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). All engineering programs are accredited by the Engineering Accreditation Committee (EAC).

The degree of Bachelor of Science in Engineering Technology is awarded in the areas of Civil Engineering Technology, Electronic Engineering Technology, and Mechanical Engineering Technology offered in the evenings through the Division of Continuing Education. The Civil, Electronic and Mechanical Engineering Technology degrees are accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

Courses of study in engineering and engineering technology provide a basic general education, scientific-technological preparation in the sciences and a comprehensive introduction to an engineering or technology field. Students must select a single major field of study. However, candidates for degrees in the College of Engineering may be permitted to elect additional majors in other colleges of the University, provided that all curriculum requirements for their degree program in the College of Engineering are satisfied. Although the Department of Work Environment offers

degrees only at the graduate level, it offers courses at the undergraduate level and combined BS/MS degrees with a number of engineering programs.

Baccalaureate Options**Track II Program (five-year plan)**

Track II Engineering is an alternative five year program. It allows a phased introduction to the rigorous engineering curricula.

The purpose of Track II is to facilitate entry to an engineering discipline. Offered as an alternative to the standard four year program, this course of study prepares the student to enter any of the engineering disciplines on the completion of four semesters (two academic years) instead of the traditional two semesters. The critical math/science foundation course work which traditionally has been taken in freshman year is spread over two years. This course work (two semesters of calculus, physics and chemistry) is both academically rigorous and time consuming and, for many students in the regular program, overwhelming. The Track II extended program permits consecutive sequential scheduling of these courses: chemistry in the first semester, precalculus mathematics and chemistry in the second semester, and calculus and physics in each of the third and fourth semesters.

Students in Track II will also take courses in the required distribution areas of English composition, social sciences and the humanities. A full course load during the four semesters of the program consists of 12 to 14 semester credits compared with 17 credits required in the standard curriculum.

Students in both the standard four year program and in Track II can accelerate their progress toward graduation during the last three years by taking (optional) summer courses.

Cooperative Education Program

The newly started Cooperative Education program for undergraduates combines academic studies with work experience in appropriate positions in the public or private sectors. It permits students to participate in a flexible schedule of study and work that is related to their academic

COLLEGE OF ENGINEERING

College Policies and Requirements

fields of study and to receive academic credit for the work experience.

All engineering students may participate in this program following completion of the freshmen year and at least one full academic semester in good academic standing at UMass Lowell. It enables a student to work in industry and to complete a baccalaureate program in five years.

The Cooperative Education program in Engineering is administered by the Dean in collaboration with the Director of Career Services and assisted by a College Coop Coordinator and individual departmental coordinators

Dual Degree Program: Bachelor of Science in Engineering Bachelor of Arts

The College of Engineering and the College of Arts and Sciences offer a five year dual degree program which permits the student to earn a Bachelor of Science in Engineering degree in a designated field (civil, chemical, electrical, mechanical, nuclear or plastics engineering) while simultaneously earning a Bachelor of Arts degree in American studies, art, English, foreign languages, history, political science, philosophy, psychology or sociology.

Students entering the Engineering/ Liberal Arts program must meet the entrance requirements of both colleges and must complete the University core requirement. Curricula for dual degree programs are approved by the faculties of the participating colleges and must be completed as prescribed. Both the Bachelor of Arts (B.A.) and the Bachelor of Science in Engineering (B.S. Eng.) degrees are conferred at the end of the fifth year. The conferral of the Bachelor of Arts degree is contingent upon the completion of all the requirements for the degree of Bachelor of Science in Engineering.

Students entering the engineering/liberal arts dual degree program should refer to the specific requirements of the appropriate engineering and liberal arts requirements which are found in this catalogue. Further information on these requirements is available from the Dean of the College of Engineering or from the Dean of the College of Arts and Sciences.

Dual Degree Program with other Colleges (3+2 plan)

A formal "3+2" engineering program is jointly offered by St. Anselm College, Gordon College, and the University of Massachusetts Lowell. This program enables a student to gain both a liberal arts education and a professional engineering education, earning a Bachelor of Arts degree from St. Anselm College or Gordon College usually at the end of the fourth year, and a Bachelor of Science Degree in Engineering from the University of Massachusetts Lowell. Students in this program will enter St. Anselm College or Gordon College and study for three years, gaining a broad liberal arts education combined with the necessary math/science foundation courses. These students then enroll at the University of Massachusetts Lowell for two additional years, completing a professional BS engineering program.

Combined Bachelor of Science in Engineering/Master of Science in Engineering Degrees Program (five-year plan)

In order to encourage outstanding undergraduate students to continue their studies toward an advanced degree, the College of Engineering and the Graduate School offer a program of accelerated study which leads to a Bachelor of Science in Engineering/Master of Science in Engineering degree. Students taking full advantage of the combined program ordinarily finish the Master of Science in Engineering degree at the end of the fifth year of study.

To be eligible to enter this course of study, a student must file a formal Graduate School application in the junior year. Applicants for this program are not required to take the Graduate Record Examination. Upon recommendation of the student's advisor and with the approval of the department graduate admissions committee and the Dean of the Graduate School, the student may be admitted as a provisional graduate student during the second semester of the senior year.

Certain graduate or advanced undergraduate (400 level) courses that an undergraduate in this program takes during the senior year may be used to satisfy both the graduate and undergraduate degree

requirements within a limit of credits established for each department.

A student in this program may be eligible for financial assistance, i.e., fellowships and teaching assistantships, during the fifth year of study. Acceptance of this assistance and the attendant responsibilities may delay the completion of the program beyond the five years.

Graduate Programs

The education of engineers in state-of-the-art areas of advanced technology and the University's commitment to national and regional economic development are the major premises upon which the graduate programs in the College of Engineering are based. These programs are intended to produce engineers whose education not only develops expertise in the design, development and production of products, but also an understanding of the management involved in the creation of new products, companies and service organizations. Thus, the graduate programs in engineering are intended to educate engineers capable of keeping abreast with the rapidly changing technology that characterizes the high technology economy of the northeast. The programs lead to degrees of Master of Science in Engineering, Master of Science, Doctor of Science, Doctor of Philosophy, and Doctor of Engineering.

General College of Engineering Requirements

Each candidate for the undergraduate degree must satisfy the general requirements of the University of Massachusetts Lowell in order to graduate. The student must also meet the specific academic requirements of the College of Engineering as indicated in this section as well as complete all credits and courses required by the department in which the student majors. The number of credits required for the completion of each College of Engineering program is established by the department offering the program.

Courses taken by freshmen entering any engineering discipline (except in Track II) are for the most part similar and include calculus, physics, chemistry, college writing, and engineering design.

Introduction to Engineering (25.107 and 25.108) introduces freshmen to the computer skills and the engineering design process as the method engineers use to solve open-ended problems. Topics include: How to identify a problem, How to develop alternative solutions, How to select the best alternative, How to make ethical decisions, and How to work as a team. Students in these courses participate in a variety of design projects depending on their anticipated choice of major. The computer skills introduced include the use of the VAX mainframe computer and IBM-compatible PCs, software packages for use with arrays and matrix algebra, statistics, and mechanical drawing.

Students who have completed their freshman programs with a grade-point average of 2.50 or better automatically qualify for admission to the sophomore program of their choice. Students who fail to achieve that required average will be admitted to the sophomore year of engineering programs only upon the recommendation of appropriate departmental committees.

Please refer to the University grade-point average policy for satisfying retention and graduation requirements.

Individuals who are not granted continued matriculation in the College of Engineering but who satisfy University retention requirements may file for intercollegiate transfer within the University. Students who are dismissed from the College of Engineering and who are ineligible to file for intercollegiate transfer or who are denied admission to another college following application for intercollegiate transfer are dismissed from the University.

Professional Programs of Study

Students who are enrolled in the College of Engineering are, of necessity, committed to pursue one of the established degree-granting programs. They are, therefore, required to make an initial declaration of a degree major (course of study) upon enrollment.

Change of Program

Students who wish to change their declarations of program within the College of Engineering are required to follow the procedure stipulated in this catalogue under "University Academic Policies: Change of Major within College of Enrollment." It should be noted that College of Engineering students who change their programs within the College of Engineering after the first semester of the sophomore year should expect to have to take semester credits beyond the minimum degree requirement, and thus extend the normal four-year period of study.

Students who wish to change from engineering to a major which is offered by another college within the University of Massachusetts Lowell must apply for an intercollegiate transfer. These procedures are described under "University Academic Policies: Change of Major with Intercollegiate Transfer."

Qualified students from other colleges in the University of Massachusetts Lowell may transfer into degree programs of the College of Engineering using the same procedure. However, these students may expect to extend their period of study beyond the normal four-year period, particularly if they transfer after the first semester of the sophomore year.

Declaration of Second Major

Candidates for degrees in the College of Engineering may be permitted to elect additional majors offered in other colleges of the University, provided that all curriculum requirements in engineering are satisfied.

Engineering students who wish to take on a second major which is offered by the College of Engineering or by another college must formalize this intent by the start of the junior year. At that time the student is also required to submit for approval his or her intended program of study to the advisor in the department offering the second major. It should be noted that in most cases, the election of an additional major will extend the normal four-year period of undergraduate study. Students who elect to take a second academic major in another college are candidates for one degree in the College of Engineering only. A student who pursues an academic major

in the College of Engineering and another college or two majors in the College of Engineering is subject to all degree requirements of the College of Engineering and is subject only to major course requirements specified by the department of the secondary major. For a complete statement of University Policy on double majors, refer to "University Academic Policies: Major Field Requirements," which appears elsewhere in this catalogue.

Transfer Policies of the College of Engineering

General Policies

It is the policy of the College of Engineering to accept transfer students from other institutions as well as from other colleges within the University of Massachusetts Lowell. Such students may expect recognition of previously completed courses

if these are equivalent to those which are specified by the curricula of the College of Engineering. Transfer students are required to have at least a 2.5 grade-point average in order to be admitted to the College of Engineering.

Transfer from Other Institutions

UMass Lowell participates in the Joint Admissions Program of the Massachusetts Community Colleges and the University of Massachusetts. According to this program, a student from one of these community colleges is guaranteed admission to UMass Lowell provided the student is enrolled in a designated transfer program and earns an associate degree with a 2.5 or higher cumulative grade point average.

Courses which are transferred from other institutions are initially evaluated by the Office of Admissions in terms of general University of Massachusetts Lowell requirements. Professional courses are subsequently evaluated by the departments in which the student has been accepted. Credit is given for completed courses where the grade is C (2.000 on a 4.000 scale) or better.

The University of Massachusetts Lowell also subscribes to the Commonwealth Transfer Compact. Under this compact, the holder of an associate degree from a

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compact institution receives up to 66 credits for this work toward a Bachelor of Science in engineering or technology. Courses which are transferred to the University of Massachusetts Lowell under the provisions of the Commonwealth Transfer Compact, but which do not meet the credit requirements of the College of Engineering, or which are not acceptable as unrestricted elective courses, will be listed on the student's transcript, but will not apply to the minimum degree requirements.

In the event that a student who has first transferred to some other college in the University of Massachusetts Lowell under the Commonwealth Transfer Compact and subsequently makes a transfer to the College of Engineering, all previously completed courses, including transferred courses from other compact institutions, will be re-evaluated in terms of their applicability toward degree requirements of the College of Engineering.

The policies of each of the colleges in the University determine the applicability of grades received in transfer to the grade-point average of the student's major at the University of Massachusetts Lowell. It is the policy of the College of Engineering not to count such grades for the purpose of determining the student's grade-point average in his or her professional area.

2 + 2 and 2 + 3 Transfer Programs

The College of Engineering has been a leader in the development and implementation of 2 + 2 and 2 + 3 Programs in the Commonwealth of Massachusetts. More and more students who are interested in earning a Bachelor of Science degree in one of the engineering disciplines pursue their first two years of the curriculum at selected community and state colleges and complete the degree requirements during two to three final years at the University of Massachusetts Lowell. The program is ideal from the standpoint of the student who is not ready to enter a four-year college, allowing the participant to ease into college life while still remaining close to home and within the environment of a smaller college.

The contractual agreements among participating schools require an on-going review of coursework normally offered in the first

two years. Curricula and other requirements are carefully established and examined by faculty at both institutions.

Transfer agreements vary with each institution participating in the 2 + 2 or 2 + 3 programs. Some participating colleges offer programs which prepare students for transfer to mechanical and electrical engineering; programs in other schools lead to entry into chemical or civil engineering. High school students who are considering this program should consult the office of admissions at the University of Massachusetts Lowell for information about available programs in participating institutions.

Repetition of Transferred Courses

A student who has been granted transfer credit from another institution, and on this basis has been assigned to advanced courses for which the transferred course is a prerequisite, may be subsequently advised to repeat such transferred work at the University of Massachusetts Lowell. Such cases arise when preparation of the student is demonstrably inadequate to allow successful performance.

To repeat a transferred course a student must file an academic petition with the Dean of the College. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a "request to revoke recognition" statement to dispose of the previously transferred course credit.

Intercollegiate Transfer to the College of Engineering

Students wishing to transfer to the College of Engineering from another college within the University of Massachusetts Lowell, or from a baccalaureate (degree granting) Division of Continuing Education program must file a form for change of major together with a transcript, with the Dean of the College of Engineering and with the appropriate engineering department head. Petitions for transfer must be filed no later than November 1 in order to transfer in the spring semester, and no later than April 1 in order to transfer in the fall semester.

Any student who wishes to transfer from

another college in the University to the College of Engineering must have a minimum grade-point average of 2.500. Irrespective of the grade received, all courses which may not be applied to the College of Engineering program requirements will be deleted from the student's cumulative grade-point average.

For further procedural details about the University's policies concerning intercollegiate transfers, students are referred to "University Academic Policies: Change of Major with Intercollegiate Transfer," elsewhere in this catalogue.

College of Engineering: Course Prefix Codes

The University uses a prefix number for each program of study.

Course prefixes assigned by the College of Engineering are as follows:

Chemical Engineering	10
Civil Engineering	14
Civil Engg Technology	15
Electrical Engineering	16
Electronic Engineering Technology	17
Work Environment	19
Mechanical Engineering	22
Mechanical Engg Technology	23
Nuclear Engineering	24
Intracollegiate Courses	25
Plastics Engineering	26

Intracollegiate Engineering Courses (Course Prefix: 25)**25.107 Introduction to Engineering I**

This course is intended for freshmen in all engineering majors, as well as others who would like to develop their basic computer skills. It provides a variety of computer skills common to all of the engineering disciplines. Students learn how to access the Internet and the WWW, and how to send and receive messages via E-mail. Software packages for use with arrays, complex numbers and matrix algebra, statistics, and mechanical drawing are introduced. This is followed by four weeks of instruction in a high-level computer language, and two weeks of a modern graphical programming language. Applications include graphing data, curve fitting, and solution to sets of equations. Exposure to

Department of Chemical and Nuclear Engineering

word processing and spreadsheets is provided as well.

25.108 Introduction to Engineering II

This course is intended for freshmen. It provides hands-on introduction to the engineering design and manufacture process via four-week modules in specific engineering disciplines. Attention is paid to the importance of quality, communication skills and the engineering design process as the method engineers use to solve open-ended problems. Topics include: How to identify a problem, How to develop alternative solutions, How to select the best alternative, How to make ethical decisions, and How to work as a team. Students participate in one of a variety of design projects depending on their anticipated choice of major. The course also provides an overview of job and coop opportunities in different engineering disciplines and strategies for success in school.

25.110 Introduction to Materials I

This course is designed to introduce the first year engineering student to the technology of materials and to demonstrate by way of examples the enormous impact that achievements in this technology have had on our way of life. Each materials specialty will be presented in terms of historical origins leading to the current state of art, with emphasis on the interplay between composition, structure, and properties with processing to manufacturing.

25.225 Technical Communication for Engineers

Provides students with the knowledge and skills to communicate successfully through presentations and written documents. The thoughts to be transferred are examples of business and technical subjects. Various forms of technical/business communications are addressed. These include the memorandum, the business letter, the proposal, the résumé, the lab report, the major report, and the oral presentation.

Department of Chemical and Nuclear Engineering

Alfred A. Donatelli, Chairperson

Thomas Vasilos, Coordinator for Chemical Engineering Graduate Program

Gilbert J. Brown, Coordinator for Nuclear Engineering Option

John R. White, Coordinator for Energy Engineering Graduate Program

Professors: Francis J. Bonner, Gilbert J. Brown, Alfred A. Donatelli, Dominick A. Sama, James R. Sheff, Thomas Vasilos, John W. Walkinshaw and John R. White.

Associate Professors: Changmo Sung and Randall W. Swartz.

The Department of Chemical and Nuclear Engineering offers undergraduate programs leading to the B.S. degree in Chemical Engineering, as well as Master's and Doctoral programs in Chemical Engineering and Energy Engineering.

The undergraduate program has the objectives of providing: A broad, fundamental base from which graduates can pursue opportunities in the field of chemical engineering; An exposure to new applications in industries of regional importance; A firm background for the pursuit of advanced degrees in engineering.

The Department combines a traditional undergraduate program in Chemical Engineering along with a unique opportunity to specialize in areas of individual interest. Options in Nuclear Engineering and Paper Engineering or concentrations in Biochemical Engineering, Engineered Materials and Computer-Aided Process Controls are offered. A general discussion follows.

The undergraduate program requires courses in basic sciences and mathematics. These provide a firm understanding of fundamentals, help the student develop analytical techniques, and serve as the basis for specialized engineering courses.

A second component consists of courses that serve as an introduction to engineering, link the basic sciences and engineering, and introduce engineering analysis, synthesis and design.

General education courses in the social

sciences and humanities are woven throughout the curriculum. These broaden perspectives, maintain and improve communication skills, and sensitize engineering students to concepts of values and ethics.

The curriculum emphasizes the study of advanced problems and topics in engineering design. The purpose is to develop skills in the use of science, sensitivity in the application of ethical considerations, sensibility in economic matters, and creativity in solving engineering problems.

Laboratory work and computer applications are extensive in the program.

Throughout the undergraduate program, the Department aims at helping the students to develop a command of generic computational tools. In the first year, students learn programming for personal computers, operation of networked computer systems, and the basics of computer aided design. In the second year, they learn the common numerical methods encountered in the solution of chemical and nuclear engineering problems. Thereafter, most courses utilize computational methods and tools to solve problems and explore new frontiers in chemical and nuclear engineering; throughout, the computer is viewed as a tool available to the effective engineer.

The Department graduates engineers who are expected to have a knowledge of chemicals and radioisotopes and their productive uses in society. They are also expected to have an understanding of the ethical, social, economic, and safety considerations of good engineering practice.

Members of the faculty are active in research aimed at increasing thermal efficiency and decreasing any adverse environmental impact in the chemical and nuclear industry. In power generation, the Department is looking at advanced nuclear designs, solar generation and other alternatives which minimize environmental emissions.

Advanced courses in power systems, thermodynamics and second-law analysis are offered regularly. New offerings in areas such as space nuclear applications, biotechnology, and environmental engineering are developed and offered based on the needs and interest of the faculty and students.

The computational facilities and the expertise of the faculty make it possible for the

COLLEGE OF ENGINEERING

Department of Chemical and Nuclear Engineering

students to look in depth at system controls and at engineering modeling and simulation. They also learn to apply computational methods to the numerical solution of transport equations.

The undergraduate curriculum is accredited by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET).

Five Year Bachelor of Science/Master of Science in Engineering Program

The Department offers a special five year program which makes it possible for qualified students to complete the requirements for the B.S. degree and the M.S. degree in five years. During the first three years, the course work under this program is the same as that specified for students in the four year bachelor program. In the junior year, students with at least a 3.00 cumulative grade point average may be admitted into the B.S./M.S. program. Those students will normally take two or three graduate-level courses in their senior year, which may be counted for both the undergraduate and the graduate degrees. This gives them a six to nine credit head start on their M.S. program in Chemical, Materials, or Energy Engineering, which normally can be completed in the fifth year.

Financial Support and Professional Activities

There are different sources of support for students in the Department to enhance their professional development. A number of scholarships are available to qualified students in chemical engineering, in the paper engineering option, and in the nuclear engineering option. A tuition waiver is available to qualified Massachusetts residents.

Undergraduates are encouraged to gain practical experience and are directed to employment in industry. Through a Cooperative Education Program, it is possible for an undergraduate student to integrate productive work experience with academic studies. Because of constraints imposed by course prerequisites and departmental offerings, however, work intervals of less than nine months must be carefully planned by the student with the help of the advisor. Part time or summer work experience opportunities are avail-

able as well. The department also encourages students to take the Fundamentals of Engineering examination.

Program in Chemical Engineering

Alfred A. Donatelli, Program Coordinator

Thomas Vasilos, Graduate Coordinator

While the undergraduate program in Chemical Engineering maintains its traditional role to educate students for employment in the chemical processing industries and to prepare them for advanced work at the graduate level, the curriculum highlights new applications especially in industries of regional importance.

Chemical engineering is a dynamic profession: there are frontiers with exciting opportunities in traditional areas as well as in new fields. Very early in the program, students are exposed to the frontiers of chemical engineering, such as microstructured materials (biotechnology and biomedicine), and go on to considerations of liquid fuels, recycling, advanced adhesives, smart materials, environmental remediation, and colloids.

Established features of the local economy are the vigorous entrepreneurial and high tech industries that both reflect and lead national trends and that are especially pertinent to emerging trends in chemical engineering. This presents a timely opportunity to the Department to contribute significantly both in the progress of our local and national economies and to the progress of the profession.

Examples of some of the on-going projects include:

Bioprocessing and Bio-Materials

Research in the areas of bioprocessing and in nanocrystalline materials is expanding. Large scale bio-manufacturing constitutes a major Departmental interest. The Massachusetts BioProcess Development Center, based at the University, serves as an incubator for the biotechnology industry and aids early stage companies with process research and preparation of test materials. In a laboratory for the study of biomaterials, progress is being made on nonlinear ("smart") optical materials and on biopolymers. Work proceeds in the

areas of nanocrystalline materials and on the bioassisted-remediation of toxic sites.

High Temperature Composites

Research and teaching in the high temperature ceramics area are on-going. There is an emphasis on materials courses, from a basic introduction to materials offered to freshmen to several advanced courses in materials and ceramics. A high temperature hot press for the processing of advanced high temperature composites, combined with air atmosphere sintering furnaces and milling equipment, provide an overall ceramic and composite materials processing facility.

Colloid and Interfacial Science and Engineering Program

The Department has an on-going effort in colloidal and interfacial science and engineering directed toward improving processes and products related to composites, ceramics and bio-medical materials. Courses on colloids and interfacial science and engineering are regularly offered. Examples of on-going research work include studies involving suspension polymerization, hydrogels, and non-aqueous gels of preformed colloidal particles.

Recycling and Toxic Use Reduction

The University of Massachusetts Lowell has taken a leading regional role on recycling and on toxic substance use reduction. Important research is being done in the diverse departments of the University, in cooperation with the Massachusetts Toxic Use Reduction Institute at the University.

Complementing those efforts, traditional strengths in the area of paper have expanded research in environmental engineering and recycling. Courses in solid waste management, paper, and environmental engineering are offered.

Drawing from a strong background in paper manufacturing, evaluation, and recycling, the eventual goal is to establish in the Department a regional center of excellence for recycling.

The Nuclear Option

The Department offers a formal option in Nuclear Engineering with a focus on nuclear processes and technology and on

Department of Chemical and Nuclear Engineering

nuclear electric power generation. The option consists of a sequence of four courses that are specifically designed to give a traditional chemical engineer concentrated training in a variety of nuclear technologies. Chemical engineering graduates with the Nuclear Option can help the nuclear industry face current and future technical challenges in areas such as the safe disposal of nuclear waste, continued safe and economical operation of existing nuclear power plants and processing facilities, improved plant performance, design of new facilities, and other advanced industrial and medical applications of nuclear technology.

The Paper Option

The Department offers the chemical engineering student a formal option in paper engineering, and several courses are taught on paper and paper-like materials.

As the demand for paper and paper products continues to grow, concerns about deforestation and waste have prompted legislation at both the state and federal levels requiring minimum recycle fiber contents in many consumer grades of paper. There is a particular interest in exploring the expanded use of recycled cellulose waste fibers in commercial and industrial products and in the evaluation of the properties of paper and paper products. The Department has nationally recognized expertise in determining recycled fiber content.

Concentration In Biochemical Engineering

The Department offers a concentration in biochemical engineering designed to help prepare the student for work in the biopharmaceutical or biotechnology industry. The student takes specified biology courses, 81.111 or 81.201, in the fall of the sophomore year and 81.548 in the junior year plus 10.535 and 10.545 in the senior year. The completion of two additional courses may also qualify the student for the Graduate Certificate in Biotechnology and Bioprocessing (see graduate catalog for details).

Concentration In Engineered Materials

The Department offers a concentration in engineered materials so that the student

can develop a specialization in that area. Courses are taught in ceramics, paper and polymeric materials.

Concentration in Computer-Aided Process Controls

The Department offers a concentration in computer-aided process controls in which students can develop a specialization in that area. Courses are taught on the hardware and software aspects of computer control and advanced methods of chemical process design, analysis and control.

Nuclear Science and Engineering Minor

Students majoring in most fields of science and engineering should have the required background to pursue a minor in the area of Nuclear Science and Engineering. Graduates with some focused training in the nuclear area can help the nuclear industry face current and future technical challenges.

The Nuclear Science and Engineering minor consists of 18 credits of required course work that follows one of two tracks. Three core courses are common to both tracks and form the basis of the nuclear focus. The remaining three courses for the minor are taken from either a Science or an Engineering track.

Interaction with Industry

The Chemical Engineering Program works closely with its Industrial Advisory Committee, which has been expanded and continues to meet regularly to advise on matters relating to scholarship moneys, program modifications and improved academic/industrial interactions.

Professional Activities

Chemical Engineering students have the opportunity to join the student chapter of the American Institute of Chemical Engineers and/or the student chapter of the Technical Association of the Pulp and Paper Industry. A local chapter of the Chemical Engineering Honor Society, Omega Chi Epsilon, is open to qualified students.

Course of Study in Chemical**Engineering****(Bachelor of Science in Engineering)**

Required for 2000 Graduates and Those Following

Freshman Year**First Semester**

25.107	Intro to Engineering I	2
42.101	College Writing I	3
84.121	Chemistry I	3
84.123	Chemistry Lab I	1
92.131	Calculus I	4
95.141	Physics I	3
96.141	Fund Exp Physics I	1
		17

Second Semester

25.108	Intro to Engineering II	2
42.102	College Writing II	3
84.122	Chemistry II	3
84.124	Chemistry Lab II	1
92.132	Calculus II	4
95.144	Physics II	3
96.144	Fund Exp Physics II	1
		17

Sophomore Year**First Semester**

10.203	Chem Eng Calc I	3
10.217	Computer Applications	3
49.201	Gen Education Elective(1)	3
92.231	Calculus III	4
	Gen Education Elective(1)	3
		16

Second Semester

10.204	Chem Eng Calc II	3
10.206	Fluid Mechanics	3
84.344	Physical Chemistry I(2)	3
92.271	Diff Eq Chem/Nucl Eng	3
	Gen Education Elective(1)	3
		15

Junior Year**First Semester**

10.305	Heat Transfer	3
10.308	Engineering Materials	3
10.315	Unit Operations Lab I	2
84.221	Organic Chemistry I-A(3)	3
84.345	Physical Chemistry II	3
84.347	Physical Chem Lab II	1
	Gen Education Elective(1)	3
		18

Second Semester

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10.306	Transport Phenomena	3
10.310	Separation Processes	3
10.311	Thermodynamics	3
10.316	Unit Operations Lab	2
84.205	Organic Chem Lab	1
84.222	Organic Chemistry II-A(3)	3
	Gen Education Elective(1)	3
		18

Senior Year

First Semester

10.403	Reactor Design	3
10.409	Eco & Process Analysis	3
10.413	Process Dyn & Control	3
10.—	Chemical Eng Elective(4)	3
	Tech Elective(4) or ROTC	3
		15

Second Semester

10.410	Plant Design	3
10.416	Process Operations Lab	2
10.—	Chemical Eng Elect.(4)	3
	Tech Elective(4) or ROTC	3
	Gen Education Elective(1)	3
		14

Total credits: 130

- (1) Economics I or II is required to partially satisfy the Behavioral and Social Science portion of the University General Education requirements.
- (2) Listed corequisite, 84.346, Physical Chemistry Lab, is not required for Chem. Eng. (CN) majors.
- (3) Listed corequisite, 84.229 or 84.230, Organic Chemistry Laboratory is not required for CN majors.
- (4) These elective courses must have a combined total of three (3) engineering design credits.

**Chemical Engineering
(Course Prefix: 10)****10.203 Chemical Engineering
Calculations I**

Introduction to the field of chemical engineering and solution of problems involving units and dimensions, mass balances, flow sheets and gas relationships. Prerequisite: 84.122. (3)

**10.204 Chemical Engineering
Calculations II**

Continuation of Chemical Engineering Calculations I including real gas relationships, humidity, energy balances, and the combined mass-energy balance systems. Prerequisite: 10.203. (3)

10.206 Fluid Mechanics

Treatment of the fundamentals and applications of fluid mechanics: laminar and turbulent flow in conduits and past immersed bodies, flow measurement, pumps, turbines, mixers. Prerequisite: 92.231. (3)

**10.217 Computer Applications in
Engineering Design**

An introduction to computers as a problem solving and communications tool and to applied numerical methods. Topics such as roots of equations, systems of linear equations, curve fitting, numerical integration, ordinary differential equations, etc., are treated with an emphasis on applications. Good computer programming skills are emphasized using the Matlab language. Good communication skills are also stressed. Prerequisite: Some minimal prior computing experience and a general working knowledge of a programming language are assumed. Mathematics background should include two semesters of Freshman calculus. (3)

10.305 Heat Transfer

Fundamental principles of heat transmission by conduction, convection, radiation and evaporation. Applications of these principles to the solution of industrial heat transfer problems and to the design calculations for heat exchange situations. Prerequisite: 10.204. (3)

10.306 Transport Phenomena

Introduction to the theory of the transport processes. Integral and differential approaches are used to develop the macroscopic and microscopic forms of the conservation laws. The conservation laws are used to solve practical problems in the chemical and nuclear industry. Prerequisite: 92.271. (3)

10.308 Engineering Materials

A general overview of solid materials which are likely to be considered for engineering applications in, or be produced by the chemical process industries. They will be discussed from the viewpoints of their units structures, appropriate phase dia-

grams, their chemical and physical attributes, and the association of these to end use applications. Discussion of metals, ceramics, polymers, and to a limited degree, composites. Prerequisite: junior standing or permission of instructor. (3)

10.310 Separation Processes

Introduction to equilibrium staged and other separations, including distillation, adsorption, absorption, membrane and chromatographic based separations. Unifying fundamental relations and concepts are emphasized. Prerequisites: 10.206, 10.305, 92.231. Corequisite: 10.311. (3)

10.311 Engineering Thermodynamics

Development of the first and second laws of thermodynamics, P-V-T relations, mathematics of property changes, generalized correlations of thermodynamic properties, application of thermodynamics to problems of phase and chemical equilibria. Prerequisite: 92.231. (3)

10.315 Unit Operations Laboratory I

Experimental projects treat fluid flow and heat transfer in a unit operations format. Experimental design and use of laboratory resources discussed. Written reports required. Prerequisite: 10.206. Corequisite: 10.305. (2)

10.316 Unit Operations Laboratory II

Experimental projects treat heat and mass transfer, including staged operations, in a unit operations format. Process measurement and calibration emphasized. Written reports required. Prerequisite: 10.315. Corequisite: 10.310. (2)

**10.331 Introduction to Nuclear
Engineering I (same as 24.331)**

Review of relevant nuclear physics topics including nuclear stability, various forms of radiation, radioactive decay, and the interaction of radiation with matter. Emphasis is placed on neutron reactions in various core and structural materials, neutron cross sections, and the development and analysis of the neutron balance equation applied to various reactor types. Key aspects of nuclear reactor core physics and shielding design are treated. Prerequisite: 92.271 or equivalent. (3)

Department of Chemical and Nuclear Engineering

**10.332 Introduction to Nuclear Engineering II
(same as 24.332)**

A continuation of 10.331 with additional focus on heat removal and energy conversion in pressurized and boiling water reactors. Heat transfer in fuel elements and shields and the thermal and flow characteristics of boiling and non-boiling liquids. First and Second Law analysis of power plant systems and components. Engineered safety and overall reactor core and plant design considerations. Prerequisite: 10.331. (3)

10.402 Engineering Analysis of Coating and Converting Systems

Lectures and problems concerned with the engineering design, technology and economics of paper and paperboard processes. Rheology and engineering properties of coating materials. Mechanical processes, coating, impregnating, laminating, printing processes, ceramic glazes and porcelain enamels are discussed in detail. Prerequisite: permission of instructor. (4)

10.403 Kinetics and Reactor Design

Review of principles underlying rates of transformation of matter and energy; effect of temperature and catalysis on chemical reactions. Introduction to the basic ideas underlying chemical reaction engineering. May be taken for graduate credit. Prerequisites: 10.311, 84.345. (3)

10.405 Design of Paper

Fundamentals of the mechanical and optical testing of paper and allied products. Discussion of engineering mechanics involved in various testing procedures. Statistical analysis of test data. Structure of materials revealed by physical tests. Laboratory projects designed to illustrate problems in development of paper products and associated required processes. Prerequisite: permission of instructor. (3)

10.409 Economics and Process Analysis

Economic evaluation of manufacturing operations and projects. Accounting terms, time value of money, evaluation of investment alternatives. A major part of the required work involves the development of written plans for establishing specific enterprises. Oral presentations of findings are required. Prerequisites: 10.206, 10.217, 10.305, 10.310. (3)

10.410 Chemical Plant Design

This course is the logical continuation of 10.409. The principles of technical and economic evaluation are applied to specific chemical engineering problems. A group of students is given a statement of the problem. They are required to find information on raw materials, products, thermodynamic parameters and plant practices in order to develop the assumptions required to carry out an examination of technical and economic feasibility. Each group generates a final report for each problem. Homework is also assigned to assist the student in the specifics of the problems. Prerequisite: 10.409. (3)

10.413 Process Dynamics and Control

An introduction to chemical process control. Description of processes and equipment by differential equations and the Laplace transform. Development of block diagrams. System stability is studied by both root locus and frequency response methods. May be taken for graduate credit. Prerequisites: 10.306, 10.217. (3)

10.416 Process Operations Laboratory

Experimental projects dealing with heat and mass transfer, separations and process control. Written and oral reports required. Prerequisites: 10.310, 10.413. (2)

10.419/20 Special Senior Projects

Original research projects primarily in the chemical engineering field and supervised by a staff member of the department. Written reports required. Prerequisite: permission of instructor. Credits arranged.

10.431 Nuclear Reactor Systems and Operations (same as 24.431)

Review of plant systems and operations. Familiarization with actual startup and operation of the UMass Lowell reactor. Detailed study, operation, and measurement of parameters in key systems, including the reactor control and radiation monitoring systems, and the primary coolant transport, cleanup, and energy removal systems. Overview of regulatory concerns and technical specifications for siting and operation of nuclear facilities. Prerequisite: 10.332. (3)

10.432 Nuclear Systems Design and Analysis (same as 24.432)

A design course that focuses on the use of modern computer analysis tools for the design and analysis of nuclear systems.

Reactor physics and shielding codes and thermal and transient analysis software are introduced and used as necessary for the particular design project under study. Detailed analyses are completed by small design teams with individual responsibility for a particular aspect of the design. Oral and written communication skills are emphasized. Prerequisite: 10.332. (3)

10.493/4 Selected Topics in Paper Engineering

Topics in paper engineering. Content may vary from year to year to reflect contemporary applications of paper engineering. Prerequisite: permission of instructor. (3)

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of the instructor.

10.501 Paper Industry Process Analysis

Processes of fiber separation from raw materials, fiber purification and mechanical processing of fiber and sheet formation. Chemical engineering theory is applied to the analysis of these operations. Prerequisite: permission of instructor. (3)

10.502 Principles of Chemical Engineering

Introduction to the field of chemical engineering and solution of problems involving units and dimensions, mass balances, flow sheets and gas relationships. Non-majors only. (3)

10.504 Process Calculations of Paper and Pulp Processes

Application of chemical engineering principles to the processes employed in the pulp and paper industries. Process calculations are made and the techniques applied to the design of processes in these areas. Prerequisite: permission of instructor. (3)

10.506 Colloid and Interfacial Science and Engineering

Unifying principles and the three main classes of colloids (dispersions, macromolecular solutions and micelles) are considered. Topics covered include surface tension, work and energy, effect of surface curvature, zeta potential, surface activity and diverse applications of interest to chemical engineers. Prerequisite: permission of instructor. (3)

COLLEGE OF ENGINEERING*Department of Chemical and Nuclear Engineering***10.510 Advanced Separation Processes**

This course emphasizes separation processes requiring a rate analysis for adequate understanding, which includes most of the newer separation methods of industrial importance such as membrane, sorption and chromatographic separations. Unifying fundamental relations and concepts are emphasized. Graphical and numerical design procedures are covered. Prerequisite: 10.310 or permission of instructor. (3)

10.516 Microprocessor Control I

Single board computers and single chip controllers and how they are used in chemical process control. Prerequisite: permission of instructor. (4)

10.518 Microprocessor Control II

Programming methods for using minicomputers as process controllers; interfacing requirements and communications. Laboratory projects include both software and hardware. Prerequisite: permission of instructor. (3)

10.520 Advanced Thermodynamics

The central theme of this course is the appropriate use of the second law of thermodynamics in the analysis and design of commercial and industrial processes with a view toward the efficient use of our energy resources; whenever appropriate economic, environmental and social issues are integrated along with thermodynamic considerations. Areas of study include heat exchangers, heat exchanger networks, steam systems, cogeneration, refrigeration, separations and energy from biomass. Prerequisite: 10.311 or permission of instructor. (3)

10.521 Introduction to Environmental Engineering

Introduction to the scope and magnitude of environmental pollution with particular emphasis on air, water, and toxic (hazardous) wastes. Defining the assessment parameters necessary to resolving environmental problems. Prerequisite: permission of instructor. (3)

10.522 Computer-Aided Chemical Process Design

Process synthesis, definition, and characterization. Introduction to modular process simulation packages such as ASPEN PLUS. The use of thermodynamics and heat integration in process design. Prerequisite: permission of instruction. (3)

10.523 Electronic Materials Processing

Materials processing methods in electronics and related industries; crystal contamination control, growth, diffusion, etching, epitaxy, ion implantation, lithography, and other topics. Prerequisite: permission of instructor. (3)

10.525 Design and Use of Packaging Materials

A joint course between the Chemical and Plastics Engineering Departments that concentrates both departments expertise in materials used throughout the packaging industry. The course not only covers the material in lecture format but also through practical laboratory demonstrations. Prerequisite: permission of instructor. (3)

10.528 Advanced Transport Phenomena

An advanced study of the mechanisms of the transport processes. Transport equations are developed from both microscopic and macroscopic viewpoints. Analogies and similarities between the transport processes are discussed. Considerable emphasis is placed upon solutions to problems. Prerequisite: permission of instructor. (3)

10.530 Advanced Control Strategies

An introduction to computer control and to some of the common control strategies applied to the design of complex chemical process control systems. Prerequisite: 10.413 or equivalent. (3)

10.531 Survey of Ceramic Materials

Modern ceramics; ceramic materials processing, characterization and properties. Prerequisite: 10.308 or permission of instructor. (3)

10.532 Principles of Chemical Engineering II

Continuation of Principles of Chemical Engineering including real gas relationships, humidity, energy balances, and combined mass-energy balance systems. Non-majors only. Prerequisite: 10.502 or permission of instructor. (3)

10.533 Macromolecular Science and Engineering

This course emphasizes the relation of molecular and macroscopic properties and end-use to polymer synthesis and commercial manufacture. Pertinent fundamental principles are reviewed. Prerequisite: permission of instructor. (3)

10.534 Special Ceramic Projects

Original research projects in the ceramic engineering field and supervised by a staff member of the department. Written reports required. Prerequisite: permission of instructor.

10.535 Principles of Cell and Microbe Cultivation

This course presents the principles of biochemical engineering with an emphasis on the unit operation of cell cultivation for production of commercially important products, especially biopharmaceuticals. The bioreactor is viewed as a device for controlling the environment of recombinant and traditional cultures. Major topics include media design, kinetics of growth and production, expression systems, bioreactor types, cell physiology, and bioprocess economics. Prerequisite: permission of instructor. (3)

10.539 Mathematical Methods for Engineers (Same as 24.539)

Review of several important analytical and computational techniques from the field of applied engineering mathematics, with an emphasis on the development and application of mathematical tools for solving practical engineering problems. Topics may include linear algebra, matrix/vector calculus, ordinary and partial differential equations, numerical methods, calculus of variations, and optimization theory. Computer work is required. Prerequisite: permission of instructor. (3)

10.540 Adhesion and Adhesives

The course develops an understanding of the fundamental concepts, relations, techniques, and applications of adhesion and adhesives. Prerequisites: 10.506. (3)

10.545 Isolation and Purification of Biotech Products

Efficient isolation and purification of biological products, especially proteins, from complex natural mixtures. Design project requires students to assume the role of project manager in developing a production process for a protein. Prerequisite: permission of instructor. (3)

10.551/2 Directed Studies

The student, through regular and frequent consultation with the instructor, undertakes independent study in a particular area of chemical engineering. (3)

*Department of Chemical and Nuclear Engineering***10.555 Biopharmaceutical GMP and Licensing**

This course examines the regulatory framework in which "drugs", "biologics" and "cellular therapies" are evaluated in the United States, including the laws, regulations and the state of industrial practice. Prerequisite: permission of instructor. (3)

10.586 Biotechnology Processing Projects Laboratory

Development of manufacturing processes for the products of biotechnology are followed through a series of process unit operations. Following the synthesis, purification and formulation of a specific enzyme throughout the course, students examine interactions between process steps and evaluate the impact of each on the total production process. As a final project, students assume the role of project team leader, developing a commercial-scale production process for the enzyme. Prerequisite: permission of instructor. (3)

10.601/2 Chemical Engineering Seminar

Required of all chemical engineering graduate students. (3)

10.603/4 Materials Engineering Seminar

Required of all materials engineering graduate students. (3)

10.651/2 Selected Topics in Chemical Engineering

Advanced topics in the various fields of chemical engineering. Content may vary from year to year to reflect contemporary applications of chemical engineering. Credits arranged.

10.653/4 Selected Topics in Materials Engineering

Advanced topics in materials engineering. Content may vary from year to year to reflect contemporary applications of materials engineering. Credits arranged.

10.701/2 Graduate Research in Chemical Engineering

Graduate students perform research work under the supervision of a senior chemical engineering staff member. The thesis or project must be approved by an examining committee appointed by the department head. (3)

10.743 Graduate Research in Chemical Engineering

(3)

10.746 Graduate Research in Chemical Engineering

(3)

10.751 Advanced Projects in Chemical Engineering

Special projects laboratory undertaken by a student to expand his/her knowledge in specific fields not necessarily related to his/her thesis. Content of project, hours assigned and supervisor must be approved by the department head. Credits arranged.

10.753 Advanced Projects in Chemical Engineering

Special projects laboratory undertaken by a student to expand his/her knowledge in specific fields not necessarily related to his/her thesis. Content of project, hours assigned and supervisor must be approved by the department head. (3)

Chemical Engineering Industry Advisory Council

Mr. James L. Baird, Vice President, Artisan Industries

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Mr. Ralph L. Mondano, Executive in Residence (3M), UMass Lowell

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Mr. R.H. Steeves, Jr., C & CS Engineer Manager, W.R. Grace Company

Mr. Thomas W. Tamulevich, Exec. Vice President, Optical Fiber Technologies

Mr. Joseph Tyler, Director, Manufacturing, Abbott Biotech Corporation

Dr. Charles Watson, United Technologies, Engineering Division-North

Dr. Alfred E. Wechsler, Senior Vice President, Arthur D. Little, Inc.

Programs in Nuclear and Energy Engineering

Program Coordinator: Gilbert J. Brown

Graduate Coordinator: John R. White

The Nuclear and Energy Engineering Program offers a series of courses and research opportunities that allow specialization in the fields of nuclear and solar engineering. At the undergraduate level the program supports a formal Nuclear Option under the Chemical Engineering program and a Nuclear Science and Engineering Minor for any qualified student at the University. At the graduate level the program offers an M.S. degree in Energy Engineering with either a nuclear or solar option.

Graduates with focused training via the undergraduate Nuclear Option or Nuclear Science and Engineering Minor programs can help the nuclear industry face the

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Department of Chemical and Nuclear Engineering

technical challenges of the future in areas such as safe disposal of radioactive waste, continued safe operation of existing nuclear power plants, improved plant performance, design of new power plants, and other advanced industrial and medical applications of nuclear technology.

The Nuclear Option

The Nuclear Option in Chemical Engineering consists of a sequence of four courses that are specifically designed to give a traditional chemical engineer concentrated training in a variety of nuclear technologies. The course selection integrates the key nuclear-related subjects usually taken as part of an undergraduate degree program in Nuclear Engineering. The courses in the Nuclear Option provide a well balanced mix of engineering science, nuclear theory, design experience, and hands-on laboratory projects that combine to give the student all the elements necessary to analyze, design, and safely utilize nuclear technology in a variety of areas. The four course sequence is designed to be taken during the student's junior and senior years (one course per semester), and these courses simultaneously satisfy the bulk of the technical electives, including the design component, required as part of the standard Chemical Engineering curriculum.

The junior sequence, Introduction to Nuclear Engineering I and II, provides an overview of pertinent topics in basic nuclear physics, nuclear reactor physics and shielding, health physics concepts, heat generation and removal in a nuclear reactor, power conversion, and overall system integration and safety. In the Fall of the senior year the student will take a course in Nuclear Reactor Systems and Operations. This course involves a detailed study of the operation and integration of the various systems needed in any nuclear reactor facility. The course involves hands-on training in the UMass Lowell 1 MW research reactor, including actual operation of the reactor and familiarization with several support systems (water cleanup system, primary coolant system, heat exchangers, etc.). The fourth course for the Nuclear Option can be selected from a wide variety of nuclear-related courses offered within the Chemical and Nuclear Engineering Department or within other programs at

the University. This last course is chosen, with consultation with the student's advisor, based on the particular interests of the individual student and it gives some flexibility in focusing the student's training in one of several areas. Qualified seniors can also select the fourth course for the Nuclear Option from a variety of approved graduate courses.

Nuclear Science and Engineering Minor

The Nuclear Science and Engineering minor consists of 18 credits of required course work that follows one of two tracks. Three core courses are common to both tracks and they form the basis of the nuclear focus. These three courses are common with those required as part of the Nuclear Option in Chemical Engineering.

Nuclear Science and Engineering Core (required for both tracks)

Introduction to Nuclear Engineering I (24.331)

Introduction to Nuclear Engineering II (24.332)

Nuclear Reactor Systems and Operations (24.431)

The remaining three courses for the minor will be taken from either a Science or an Engineering track as follows:

Nuclear Science Track (choose 3 courses from the following list)

Modern Physics or Physics of Radiation and Nuclei (95.210 or 95.355)

Nuclear Instrumentation (96.306)

Radiation Safety and Control (95/96.401 and 95/96.402)

Radiation Chemistry and Radioisotope Techniques (95.441)

Environmental Radiation and Nuclear Site Criteria (95.422)

Nuclear Physics (95.461)

Nuclear Engineering Track (choose 3 courses from the following list)

Engineering Materials (10.308, 14.310/311, or 22.295)

Fluid Mechanics (10.206, 14.301, 22.381, or 26.314)

Heat Transfer (10.305, 22.341, 22.342, or 26.348)

Thermodynamics (10.311, 22.242, or 26.247)

Transport Phenomena (10.306 or 22.441)

Electrical Power Systems (16.211 or equivalent, 16.355, or 16.473)
Nuclear Systems and Operations (24.432, 24.419/420, or 24.495/496)

The Nuclear Science and Engineering minor targets students with major degrees in Physics or Health Physics or in Chemical, Civil, and Mechanical Engineering, although any qualified student with interests in this area of specialization can be admitted into the minor. Most technical disciplines already have a solid mathematics, science, and engineering foundation, and a few specialized courses in nuclear technology could open up additional avenues for employment and career growth. Most students in these major programs can satisfy the requirements for the Nuclear Science and Engineering Minor with only three additional courses beyond the normal sequence for their major program of study. In addition, the core courses from the nuclear minor may also satisfy a portion of the technical electives required by the major program.

Research Facilities

Students in the Nuclear Option or Minor can participate in ongoing faculty and graduate research using a variety of modern research tools and facilities. Program faculty are involved with the UMass-Lowell Radiation Laboratory which includes a 1MW research reactor, a Co-60 irradiation facility, a 5MeV van de Graaf accelerator, and a variety of radiation counting laboratories. The Center for Advanced Materials also houses state-of-the-art analytical equipment for the micro-characterization of materials. In addition to a large array of networked computer facilities throughout the University, the Department also maintains a computer laboratory where students can work individually or in small teams to address a variety of homework and design projects, or perform advanced research. One of the major strengths of the UMass Lowell nuclear program lies in its emphasis in advanced computational techniques, with special focus towards the development and application of numerical methods for the analysis of nuclear systems.

Nuclear Engineering Program Scholarships

The Nuclear Program is fortunate to be a participant in the U.S. Department of Energy and Industry Matching Funds Grant Program. Our industrial partners are the Boston Edison Company, Northeast Utilities, North Atlantic Energy Services Corporation (Seabrook) and Yankee Atomic Electric Company. A large portion of the funds from this industrial support program is being used to award scholarships to qualified students following programs of study that include either the Nuclear Option or the Nuclear Science and Engineering Minor. These scholarships are available to successful candidates in both the junior and senior years if the student completes the core courses with a grade and has an overall GPA greater than 2.5.

Other student scholarships, up to \$2500, are available on a competitive basis from the Institute for Nuclear Power Operations and the American Nuclear Society. Students are also eligible to apply for \$3500 need based scholarships through the American Nuclear Society and the UMass Lowell Hoff Scholarships which award up to full tuition for a maximum of six semesters. Several of our students have received these scholarships. Summer industrial internships, cooperative education work experience opportunities, and part time jobs are also available to qualified candidates.

Professional Development Activities

Students have the opportunity to gain practical experience at operating nuclear reactors through course work and through internships at the UMass Lowell Research Reactor and through cooperative education and summer work at nuclear power reactors. Students can study to take the U.S. Nuclear Regulatory Commission License examination and become a federally licensed reactor operator at our reactor. Cooperative education appointments have been arranged for selected students who worked for a year at a power reactor and then returned to school to finish their degree. Summer internships are available to students through our Seabrook Station Internship Program and at other local companies involved in nuclear related operations and support.

Students interested in the nuclear field are

encouraged to join the student chapter of the American Nuclear Society (ANS). This entitles them to receive the journal Nuclear News and to otherwise participate in the Society. A local chapter of the Nuclear Engineering Honor Society, Alpha Nu Sigma, is open to qualified students.

Both faculty and students participate in the annual ANS Regional Student Conference. UMass Lowell students attend and typically present papers based on their research, in competition with their peers at other schools. In recent years, the University has taken several awards for "best paper" in a session. Students are also encouraged to attend professional meetings of the American Nuclear Society. There is financial support for students to participate in these professional development activities.

Nuclear/Energy Engineering (Course Prefix: 24)**24.331 Introduction to Nuclear Engineering I (same as 10.331)**

Review of relevant nuclear physics topics including nuclear stability, various forms of radiation, radioactive decay, and the interaction of radiation with matter. Emphasis is placed on neutron reactions in various core and structural materials, neutron cross sections, and the development and analysis of the neutron balance equation applied to various reactor types. Key aspects of nuclear reactor core physics and shielding design are treated. Prerequisite: 92.271 or equivalent. (3)

24.332 Introduction to Nuclear Engineering II (same as 10.332)

A continuation of 24.331 with additional focus on heat removal and energy conversion in pressurized and boiling water reactors. Heat transfer in fuel elements and shields and the thermal and flow characteristics of boiling and non-boiling liquids. First and Second Law analysis of power plant systems and components. Engineered safety and overall reactor core and plant design considerations. Prerequisite: 24.331. (3)

24.419 Reactor Operator Training I

Training, including in-reactor experience and topical lectures, as given to Reactor Operator Trainees who will undergo Federal testing for a Reactor Operator

License. Prerequisite: permission of instructor. (3)

24.420 Reactor Operator Training II

Continuation of 24.419. Upon completion of this course, the student will be given a simulated Reactor Operator examination, including a written test, an oral test about reactor systems, and a controls manipulation test. Prerequisite: permission of instructor. (3)

24.431 Nuclear Reactor Systems and Operations (same as 10.431)

Review of plant systems and operations. Familiarization with actual startup and operation of the UMass Lowell reactor. Detailed study, operation, and measurement of parameters in key systems, including the reactor control and radiation monitoring systems, and the primary coolant transport, cleanup, and energy removal systems. Overview of regulatory concerns and technical specifications for siting and operation of nuclear facilities. Prerequisite: 24.332. (3)

24.432 Nuclear Systems Design and Analysis (same as 10.432)

A design course that focuses on the use of modern computer analysis tools for the design and analysis of nuclear systems. Reactor physics and shielding codes and thermal and transient analysis software are introduced and used as necessary for the particular design project under study. Detailed analyses are completed by small design teams with individual responsibility for a particular aspect of the design. Oral and written communication skills are emphasized. Prerequisite: 24.332. (3)

24.495/6 Directed Studies

Special problems in nuclear science and engineering assigned to the individual student, with emphasis on modern research methods and preparation of results for publication. Prerequisite: permission of instructor. (3)

Primarily for Graduate Students

Graduate courses are open to undergraduates with permission of the instructor.

24.501/2 Graduate Research Seminar

Presentation and discussion by faculty, invited speakers, and graduate students of recent developments in the field of nuclear

COLLEGE OF ENGINEERING*Department of Chemical and Nuclear Engineering*

and solar engineering, energy policy, and the financial and social costs of power. Weekly meetings. Required for all graduate students.

24.504 Energy Engineering Workshop

A group/individual design project. The design effort will integrate many aspects of the student's engineering background, including design concepts, technical analyses, economic and safety considerations, etc. A formal report and oral presentation are required. Prerequisite: permission of instructor. (3)

24.505 Reactor Physics

Advanced treatment of several topics in reactor physics, including cross sections and processing methods, development of transport theory, reduction to diffusion theory, and analyses of analytical and numerical solutions of the resultant balance equations. Prerequisite: permission of instructor. (3)

24.506 Special Topics in Reactor Physics

Potential topics include nodal methods, perturbation theory, data sensitivity and uncertainty analysis, fuel management and core optimization methods, noise analysis, space-time kinetics, reactor control, reactor safety, etc. May be repeated since topics vary. Prerequisite: permission of instructor. (3)

24.507 Reactor Engineering and Safety Analysis

Modeling and analysis of reactor thermal-hydraulics and safety systems. Topics include nuclear heat generation and transport, single and two-phase flow, boiling crisis, and safety analysis. Prerequisite: permission of instructor. (3)

24.508 Special Topics in Reactor Engineering

Topics will deal primarily with reactor safety issues such as containment analysis, fission product release during accidents, probabilistic risk assessment, core concrete interactions, and standardized plant design. Prerequisite: permission of instructor. (3)

24.509 Systems Dynamics

Mathematical foundation using the state-variable approach. Topics include matrix methods, Laplace transforms, transfer functions, frequency response and stability analyses, and distributed/lumped paramete-

ter systems. Applications to mechanical and thermo-fluid systems. Modeling and simulation of systems using Matlab are emphasized. A comprehensive project, including formal written and oral reports, is required. Prerequisite: permission of instructor. (3)

24.511 Advanced Reactor Concepts

Current designs for advanced reactor concepts. The physics, engineering, and safety of the various designs will be examined, with emphasis on the innovative aspects of each concept. Oral and written reports will be required. Prerequisite: 24.332 or 24.505. (3)

24.514 Nuclear Waste Management

History of nuclear waste disposal, engineering design of disposal systems. Status of present waste and the character and quantities of future wastes. Review of disposal concepts on a generic basis. The national plan for waste disposal. Prerequisite: permission of instructor. (3)

24.519 Reactor Operator Training

Training, including in-reactor experience and topical lectures, as given to Reactor Operator Trainees who will undergo Federal testing for a Reactor Operator License. Prerequisite: permission of instructor. (3)

24.520 Reactor Operator Training

Continuation of 24.519. Upon completion of this course, the student will be given a simulated Reactor Operator examination, including a written test, an oral test about reactor systems, and a controls manipulation test. Prerequisite: permission of instructor. (3)

24.521 Fundamentals of Solar Thermal Utilization (same as 22.521)

Solar radiation in space and on the earth's surface. Sunshape. Intensity and flux: effect of location and orientation. Review of heat transfer. Opaque and transparent bodies. Characterization of solar collectors. A project is required. Prerequisite: permission of instructor. (3)

24.522 Nuclear Materials

Review of metals and metal oxide properties. Radiation damage in fluids, plastics, ceramics, electronics, and graphite. Hardening, embrittlement, swelling, and creep in metals. Damage mechanisms. Shielding materials. Prerequisite: permission of instructor. (3)

24.524 Introduction to Solar Thermal Research

Overview of solar thermal projects and concepts. Solar systems as loose networks. Lessons learned and potential for improvement. Fuels and chemicals. Advanced concepts. A project is required. Prerequisites: 24.521, 24.527 or permission of instructor. (3)

24.527 Solar Systems Engineering-Commercial and Industrial (same as 22.527)

Concentrating collectors, thermal network modeling, passive design tools, photovoltaic systems, solar cooling, daylighting, solar ponds, and economics. Prerequisite: permission of instructor. (3)

24.531/2 Selected Topics in Energy Science

Individual research projects in a variety of topics in nuclear, solar, or general energy engineering and technology. Emphasis is on state-of-the-art research methods in the particular field of interest. May be repeated with consent of advisor. Prerequisite: permission of instructor. (3)

24.539 Mathematical Methods for Engineers (same as 10.539)

Review of several important analytical and computational techniques from the field of applied engineering mathematics, with an emphasis on the development and applications of mathematical tools for solving practical engineering problems. Topics may include linear algebra, matrix/vector calculus, ordinary and partial differential equations, numerical methods, calculus of variations, and optimization methods. Some computer work with Matlab will be required. Prerequisite: permission of instructor. (3)

24.541 Introduction to X Ray Diffraction

Diffraction theory as a basis for understanding and for determining crystal structure of polycrystalline materials. Crystal defects such as dislocations, twins and point defects will be discussed. Physics and chemistry of advanced materials will be covered. Qualitative and quantitative elemental analyses of second phase or precipitates on submicron scale by energy dispersive x-ray spectroscopy. Prerequisite: permission of instructor. (3)

24.545 Applied Nuclear Materials Research

Topographical and chemical features of bulk materials by scanning electron microscopy. High resolution images of surface structure of polymers and crystalline materials in three dimensions by scanning tunneling microscope and atomic force microscope. Surface chemistry by SIMS and ESCA. Applications: nanocrystalline features in amorphous materials, submicron morphological and device features, distribution and structure of interfaces and grain boundaries. Prerequisite: permission of instructor. (3)

Nuclear Engineering Industry Advisory Council

Dr. E. Thomas Boulette, Vice President, Boston Edison Company

Mr. Ted C. Feigenbaum, President, Northeast Energy Services Corp. Dr. Andrew C. Kadak, President, Yankee Atomic Electric Company

Mr. John Landis, Stone & Webster Engineering Corp.

Dr. Robert Bari, Brookhaven National Laboratory

Dr. Gail H. Marcus, U.S. Nuclear Regulatory Commission

Department of Civil and Environmental Engineering

William B. Moeller, Chairperson

Professors: Nathan H. Gartner, Donald G. Leitch, William B. Moeller, Charles R. Ott, Samuel G. Paikowsky, Burton A. Segall, and John M. Ting

Associate Professors: Clifford J. Bruell, Susan Faraji, and Hilary I. Nyang

Assistant Professors: Chronis Stamatiadis

Civil and Environmental Engineering Practice encompasses a wide range of specialties, including aerospace, air transportation, construction management, energy engineering, engineering mechanics, environmental engineering, geotechnical engineering, hydraulics, intelligent transportation systems, irrigation and drainage, materials engineering, structural engineering, surveying and site engineering, urban planning and development, urban transportation, water and wastewater treatment system design, water resources planning and management, and waterway, port, coastal and ocean engineering.

Civil Engineers plan, design, and build facilities essential to modern society: homes and work places; transportation systems for commerce and recreation, and water treatment and waste disposal systems for a healthful life. As part of the Construction Industry, they build bridges, buildings, tunnels, dams, canals, irrigation systems, harbors, highways, airports, water supply systems, and waste disposal facilities. They develop solutions to environmental problems, study new methods to control traffic, and design outer space and under sea structures.

Civil engineers work in both the public and private sector. They serve as city, town and state public works and environmental engineers. They own and are employed by consulting firms, construction companies and industries. They are employed by a variety of federal and state agencies such as, the Corps of Engineers, the Department of Transportation, the Environmental Protection Agency, the Federal Aviation Administration, Massachusetts Water Resources Authority and the Massachusetts Highway Department.

Program Objectives

The program objective of the Department is to provide its students with a well balanced, high quality education that will permit them to practice civil and environmental engineering at a professional level, that will prepare them for graduate study, that will promote life long learning and continuing professional development and that will provide them with the skills and knowledge necessary to develop into active contributors to the economic and social vitality of the region.

Undergraduate Program

The first year of the Civil and Environmental Engineering program is devoted to mathematics, science, writing, computer and graphic skills development needed for professional studies. During the second year of study, students learn surveying and principles of engineering mechanics and strength of materials. At the upper level, students study structural engineering, geotechnical engineering, transportation engineering and environmental engineering. In addition to a broad based education in these four areas of study, advanced elective courses are available in each area in the senior year. Engineering design, concepts and computer aided engineering are integrated throughout the program.

Course of Study for Civil and Environmental Engineering**Freshman Year****Fall Semester**

25.107	Intro to Engineering I	2
42.101	College Writing I	3
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.131	Calculus I	4
95.141	Physics I	3
96.141	Fund of Exp Physics I	1
		17

Spring Semester

25.108	Intro to Engineering II	2
42.102	College Writing II	3
84.122	Chemistry II	3
84.124	Chemistry II Lab	1
92.132	Calculus II	4
	(Gen Ed)Hist Studies	3
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Department of Civil and Environmental Engineering

Sophomore Year

Fall Semester

14.203	Statics	3
14.225	Surveying I & Lab	3
92.231	Calculus III	4
92.386	Stats for Sci & Engg*	3
	(Gen Ed)Beh & Soc Sci	3

Spring Semester

14.204	Strength of Materials	3
14.205	Dynamics	3
14.226	Surveying II & Lab	3
92.234	Diff Equations	3
	(Gen Ed)Literature	3

Junior Year

Fall Semester

14.301	Fluid Mechanics	3
14.310	Engg. Materials	3
14.311	Engg. Materials Lab	1
14.350	Structural Analysis I	3
14.372	Civil Engg. Systems	3
49.201	(Gen Ed)-BSEconomics I	3

Spring Semester

14.330	Soil Mechanics	3
14.331	Geotech & Fluids Lab	2
14.340	Transportation Engg	3
14.341	Transportation Eng Lab	1
14.352	Reinf Concrete Design	3
14.362	Environmental Engg I	3

Senior Year

Fall Semester

14.431	Foundation & Soil Engg	3
14.452	Steel Design	3
14.460	Water Res Engg	3
	Professional Elective	3
10.347	Elem Therm & Heat Tr	3
	(Gen Ed)Aesthetics	3

Spring Semester

14.470	Civil Engg. Economics	3
14.485	Capstone Design	3
	Professional Elective	3
16.213	Fund of Electricity	3
	(Gen Ed)Values**	3

Total Credits: 128

* or equivalent

** 45.334 Engineering and Ethics or equivalent

The Five Year BS/MS Civil Engineering Program

The purpose of this program is to offer qualified undergraduate students an accelerated program of study leading to a Master of Science in Civil and Environmental Engineering at the end of five years of study. The student benefits from the efficiency of a continuous, coordinated sequence of subjects which allows for reduced credit hour requirements. Students can receive the B.S. in Engineering at the end of the fourth year and the M.S. in Engineering at the end of the fifth year if all requirements are met.

General Requirements

Application to the five year program is made during the second semester of the junior year. A minimum grade point average of 3.0 based upon the first five semesters of grades, is required for admission into the program.

Applicants who satisfy the Graduate School and departmental admission requirements for the five-year program will be assigned to a graduate faculty member who will act as their program advisor. The M.S.C.E. degree requires the successful completion of a minimum of 30 credit hours. These 30 hours include at least 24 hours in class and seminar study, of which at least 18 hours must be at the 500 level or higher. Courses at the 400 level are designed for seniors, but may be taken by graduate students for graduate credit if written approval is given by the student's advisor.

Special Requirements

A student seeking a five year M.S.C.E. must choose an area of specialized study. These areas include: environmental engineering, geotechnical engineering, geoenvironmental, structural engineering and transportation engineering. Programs of study in each of these areas are described in the Graduate Catalog.

Civil and Environmental Engineering
(Course Prefix: 14)

14.203 Statics

Vector concepts of forces and moments of forces. Static equilibrium of particles, rigid bodies and simple structures. Friction, centroids and moments of inertia. Prerequisites: 92.132 and 95.141. I(3,0)3

14.204 Strength of Materials

Stress and strain, stress transformation, temperature stresses. Stress and deformation in bodies under axial, shearing, flexural, torsional and combined loadings. Shear and bending moment diagrams. Euler Columns. Prerequisite: 14.203. II(3,0)3

14.205 Dynamics

Vector development of kinematics of particles and rigid bodies with respect to fixed and moving coordinate systems of one, two, and three dimensions. The dynamics of particles, systems of particles, and rigid bodies. Angular momentum and the inertial properties of rigid bodies. Energy, impulse and momentum methods. Prerequisites: 14.203 and 92.231. I(3,0)3

14.225 Surveying I

A presentation of the basic methods used to measure, record, and process spatial data. Analysis and adjustment of random errors. Principles of closed and open traverses. Fieldwork practice in data collection and office-type projects in contour mapping and the application of contoured topography to highway and water-control projects. Prerequisites: 25.101, 25.102 and 92.131 or 92.125. I(2,3)3

14.226 Surveying II

Principles and practice of route surveys and designs. Topics include simple and compound circular curves, vertical alignment principles including parabolic easement curves, earthwork operations and determination of volumes. Includes office-type projects illustrative of the application of surveying information to Civil Engineering projects such as water resources, sanitary sewers and property subdivision. Fieldwork instruction in basic traverse surveys and gathering of topographic information. Prerequisite: 14.225. II(2,3)3

14.301 Fluid Mechanics

Fluid properties, fluid statics, fluid dynamics including continuity, impulse-momentum and energy equations. Pipe flow, turbomachinery, similitude and modeling, laminar and turbulent flow, boundary layer and closed conduct design. Prerequisites: 14.205, 92.234. II(3,0)3

14.310 Engineering Materials

A study of the properties of engineering materials which influence the design, construction and maintenance of Civil Engineering works. Topics such as: crystal structure, diffusion phase diagrams, and corrosion are addressed. Included are such materials as ferrous and non-ferrous metals, timber, asphalt, and cementitious materials. Prerequisites: 84.122, 14.204. I(3,0)3

14.311 Engineering Materials Laboratory

Testing and measurement techniques and material standards illustrating behavior of materials, such as metals, wood, and Portland cement concrete. I(0,3)1

14.330 Soil Mechanics

Development of the fundamental principles of soil mechanics as utilized in soil and foundation engineering. Topics include: classification, index properties, strength and stress-strain behavior, effective stress principle, permeability, flow and consolidation. Introduction to basic soil mechanics laboratory practice. Prerequisites: 14.204, 14.301, 14.310. I(3,0)3

14.331 Geotechnic and Fluids Laboratory

Laboratory experience that illustrates soil mechanics and fluid flow theory. Experiments are conducted in the soils and hydraulics laboratories. Course emphasizes data acquisition and analysis and writing engineering reports. Prerequisites: 14.301. Corequisite: 14.330. II(1,3)2

14.340 Transportation Engineering

Development of the basic principles pertaining to the movement of people and goods by modern transportation systems. Techno-economic characteristics of the various transportation modes. Aspects of planning, design and operation of land, air and water transportation facilities. Development, structure and function of the U.S. transportation system. Corequisite: 14.226. II(3,0)3

14.341 Transportation Engineering Laboratory

Application of principles of traffic and transportation systems analysis. Aspects of planning, design and operation of transportation facilities with primary emphasis on highway systems. Corequisite: 14.340 II(0,3)I

14.350 Structural Analysis

Principles of structural analysis applied to typical civil engineering structures. Emphasis on the classical methods of analysis of statically determinate and indeterminate structures with certain personal computer applications. Prerequisite: 14.204. I(3,0)3

14.352 Reinforced Concrete Design

Ultimate strength and elastic behavior of reinforced concrete structural members, continuity in building frames, deflections, shear reinforcement, development length and bar cutoffs, columns and footings. Prerequisites: 14.310, 14.350. II(3,0)3

14.362 Environmental Engineering I

Physical, chemical and biological principles of the treatment of water and sewage are considered along with their application to treatment systems. The several system components of water and sewage treatment plants are studied to provide a basis for design capability. Prerequisite: junior status. II(3,0)3

14.372 Civil Engineering Systems Analysis

Introduction to methods of operations research, management science and economic analysis used in the design, planning and managing of engineering systems. Main topics covered: systems modeling, optimization concepts, network analysis, mathematical programming, project management, decision analysis, project evaluation. Prerequisite: junior status. I(3,0)3

14.431 Foundation and Soil Engineering

The application of soil mechanics to the design and analysis of foundations and soil structures. Topics include: subsurface exploration, analysis and design of shallow and deep foundations, earth pressures, retaining structures, and slope stability. Prerequisite: 14.330. I(3,0)3

14.452 Steel Design

An elementary introduction of structural steel design with emphasis on use and interpretation of the AISC Manual and LRFD Specifications. Subjects include design of tension, compression, beams, and beam-column members, plus bolted and welded connections. Other topics may include composite beams, plate girders, building connections and plastic analysis and design. Prerequisite: 14.350. I(3,0)3

14.460 Water Resources Engineering

Elements of classical hydrology including precipitation, runoff, abstractions, groundwater, hydrographs, statistics in hydrology. Open channel flow and water law. Prerequisite: 14.301. I(3,0)3

14.463 Environmental Engineering II

A study of the effects of waste discharges on the aquatic environment. Streams, lakes and marine systems are considered. Modeling of effects are explored through use of the Streeter-Phelps equation and various modifications. Stream sampling techniques, data collection and analysis are stressed. Prerequisite: 14.362. II(3,0)3

14.470 Civil Engineering Economics

Presentation of mathematical principles of economic analysis, with emphasis on defining alternatives and predicting consequences of proposed investments. Attention is placed on the economic, social and environmental impacts of proposed Civil Engineering projects. The attractiveness of investments are judged by rate of return, equivalent cash flow and benefit cost ratio techniques. Sensitivity analysis and depreciation in economic studies are also discussed. Prerequisite: 49.201. II(3,0)3

14.475 Construction Management

Development of management skills and techniques to plan, schedule, supervise, and control construction projects. Project estimating; labor costs and productivity; construction plans, specifications and contracts; labor relations; time, cost and quality control; construction equipment and project decision making and financing. Prerequisite: senior status. I(3,0)3

COLLEGE OF ENGINEERING*Department of Civil and Environmental Engineering***14.480 to 14.483 Special Topics in Civil Engineering**

Contemporary topics in selected areas of study within civil engineering. Course content is chosen by the instructor to meet the interests of the students. I,II(3,0)3

14.485 Capstone Design

Integration of curriculum by comprehensive design exercise to professional standards. Team effort, reports, presentations, open-ended problems of analysis and design. Prerequisite: senior status. II(1,6)3

Elective Graduate Courses

The graduate courses listed below may be used as civil engineering electives with permission of the instructor and the graduate academic advisor. These courses are designed for Civil Engineering graduate students in Environmental, Geotechnical, Geoenvironmental, Structural and Transportation programs, but can also be selected as undergraduate elective offerings.

14.504 Advanced Strength of Materials

Stress and strain at a point; curved beam theory, unsymmetrical bending, shear center, torsion of non-circular sections; theories of failure; selected topics in solid mechanics. (3,0)3

14.505 Construction Occupational Safety and Health

A seminar covering various topics in construction occupational health and safety. Topics to be covered include: OSHA and Regulation, Fatalities, Fall Protection and Rigging, Confined Spaces and Trenches, Electrical and Hand Tool Safety (Lockout/Tagout), Job Hazard Analysis, Noise, Ergonomics and the Prevention of Musculoskeletal Disorders, Industrial Hygiene and Exposure to Asbestos, PNOC, Diesel and Lead, and Construction Safety Culture. Outside speakers (many will be safety representatives from construction contractors or other professionals in the construction industry) will be brought in to discuss these topics. II(3,0)3

14.507 Engineering Computation

Advanced software design and implementation for engineers. Structured programming using a modern language such as C. Theory and implementation of advanced

data structures. Numerical algorithms for systems of equations and data manipulation. Emphasis on design and implementation of software for civil engineering purposes. Prerequisites: introductory computer programming course and permission of instructor. (3,0)3

14.529 Engineering with Geosynthetics

Rigorous treatment in the mechanism and behavior of reinforced soil materials. Laboratory and in-situ tests for determining the engineering properties of geosynthetics (geotextiles, geomembranes, geogrids and geocomposites). Design principles and examples of geosynthetics for separation, soil reinforcement and stabilization, filtration and drainage. Prerequisite: 14.431 or 14.531. (3,0)3

14.531 Advanced Soil Mechanics

Theories of soil mechanics and their application. Drained and undrained stress-strain and strength behavior of soils. Lateral earth pressures, bearing capacity, slope stability, seepage and consolidation. Lab and insitu testing. Prerequisite: 14.330 or equivalent. (3,0)3

14.533 Advanced Foundation Engineering

Design and analysis of shallow foundations, excavations and retaining structures including: site exploration, bearing capacity and settlement theories, earth pressures, braced and unbraced excavations, rigid and flexible retaining structures, reinforced earth, dewatering methods and monitoring techniques. Prerequisite: 14.431 or 14.531. (3,0)3

14.536 Soil Engineering

The study of soil as an engineering material, and its use in earth dams, road embankments, flow control, and compacted fills. Stability of natural slopes, soil reinforcement and stabilization. Prerequisite: 14.531. (3,0)3

14.537 Experimental Soil Mechanics

Application of testing procedures to the evaluation of soil type and engineering properties. Testing for classification, permeability, consolidation, direct and triaxial shear and field parameters. The technical procedures are followed by data analysis, evaluation and presentation. Critical examination of standard testing procedures, evaluation of engineering parameters, error estimation and research devices. Prerequisite: 14.531.

14.539 Ground Improvement

Design and construction methods for strengthening the properties and behavior of soils. Highway embankments, soil nailing, soil grouting, landslide investigation and mitigation, dynamic compaction, stone columns. Prerequisites: 14.330 or 14.531. (3,0)3

14.540 Urban Transportation Planning

Basic principles of urban transportation planning. Characteristics of urban travel; characteristics of urban transportation systems. Data collection; analysis of travel demand; analysis of system performance. Project evaluation; project implementations. (3,0)3

14.541 Traffic Engineering

Safe and efficient movement of goods and people on streets and highways, including aspects of (a) transportation planning; (b) geometric design of street and highway facilities; (c) traffic operations and control; (d) traffic safety, and; (e) management and maintenance of transportation facilities. Topics include: traffic stream characteristics; traffic engineering studies; capacity analysis; optimization of signal timings; simulation of traffic operations; accident studies; parking studies; environmental impacts. Prerequisite: 14.340. II(3,0)3

14.543 Transportation Systems Analysis

Demand, supply and equilibrium in multimodal transportation systems. Analysis of transportation decisions; searching for optimal design strategies. (3,0)3

14.545 Public Transit

Planning and design of public transportation systems and their technical, operational and cost characteristics. Discussion of the impact of public transportation on urban development; the different transit modes, including regional and rapid rail transit (RRT), light rail transit (LRT), buses, and paratransit, and their relative role in urban transportation; planning, design, operation and performance of transit systems (service frequency and headways, speed, capacity, productivity, utilization); routes and networks; scheduling; terminal layout; innovative transit technologies and their feasibility. Prerequisites: 14.340. 14.540 while not required will be an advantage. Instructor's approval is required. I(3,0)3

Department of Civil and Environmental Engineering

14.547 Planning and Design of Airports

Planning and design of civil airports. Estimation of air travel demand. Aircraft characteristics related to design; payload, range, runway requirements. Analysis of wind data, runway orientation and obstruction free requirements. Airport configuration, aircraft operations, and capacity of airfield elements. Design of the terminal system, ground access system, and parking facilities. Prerequisite: 14.340. I(3,0)3

14.549 Traffic Flow Theory

Examination of the fundamental traffic flow characteristics - time headway, flow, time-space trajectories, speed, distance headway and density. In depth treatment of related analytical techniques including traffic stream modeling at both microscopic and macroscopic levels, supply and demand analysis, shock wave analysis, queuing analysis and simulation modeling of traffic systems. Prerequisites: 14.340, 14.541 and 14.522 while not required will be an advantage. Instructor's approval is required. II(3,0)3

14.550 Advanced Structural Analysis

Classical and matrix methods of structural analysis applied to complex plane trusses. Elementary space truss analysis. Elementary model analysis through the use of influence lines for indeterminate structures. The digital computer and problem oriented languages as analytical tools. Prerequisite: 14.350. II(3,0)3

14.551 Design of Steel Structures

Elastic and plastic design of structural steel systems, residual stresses, local buckling, beam-columns, torsion and biaxial bending, composite steel-concrete members, load and resistance factor design. (3,0)3

14.552 Behavior of Reinforced Concrete Structures

Review of behavior and strength design methods for flexure and shear, anchorage, torsion, deep beams, slender columns and beam-columns, deflections, slabs and walls. (3,0)3

14.553 Wood Structures

Review of properties of wood, lumber, glued laminated timber and structural-use panels. Review of design loads and their distribution in wood-frame buildings. Design of wood members in tension, compression and bending; and design of connections. (3,0)3

14.556 Finite Element Analysis

Direct and variational methods are used to derive equations for structural elements. Static and dynamic problems are analyzed. (3,0)3

14.561 Physical Chemical Treatment Processes

Theories of physical chemical treatment processes and the laboratory (or pilot plant) techniques necessary to obtain design. Treatment processes for natural waters, domestic wastes, and industrial wastes. (3,0)3

14.562 Physical and Chemical Hydrogeology

Well hydraulics for the analysis of groundwater movement. A review of the processes of diffusion, dispersion, sorption, and retardation as related to the fate and transport of organic contaminants in groundwater systems. Factors influencing multi-dimensional contaminant plumb formation and migration are addressed. (3,0)3

14.564 Computer Hydraulics and Hydrology

Advanced course in civil engineering hydraulics and hydrology. Development of skills and familiarization with pressure conduit and open channel hydraulic models and Corps of Engineer and Soil Conservation Services, hydrologic programs. (3,0)3

14.565 Industrial Waste Treatment Processes

An introduction to the unit operations most commonly encountered in industrial waste treatment. Specific industrial applications will be stressed after an understanding of each unit operation has been developed. (3,0)3

14.567 Environmental Chemistry I

The chemistry of natural and polluted waters and the applied chemistry of water and wastewater treatment. Dilute aqueous solution chemistry of acid-base reactions and complex formation. Emphasizes chemical equilibrium and serves as a foundation for environmental studies. (3,0)3

14.568 Environmental Chemistry II

Environmental transport of organic chemicals and atmospheric gases in air, water and soil systems. The kinetics of mass transfer from an equilibrium perspective across environmental interfaces. (3,0)3

14.570 Small and Alternative Waste Water Treatment

A design oriented course covering subsurface disposal, surface systems disposal, nonconventional collection systems and planning approaches. (3,0)3

14.571 Surface Water Quality Modeling

Theory and application of surface water quality modeling will be combined interactively throughout the course. Data from a stream will be utilized in order to bring a public domain model into operation. (3,0)3

14.573 Municipal, Industrial and Hazardous Waste Management

Characterization, handling and disposal of municipal, industrial and hazardous wastes. Technologies such as landfills, recycling, incineration and composting are examined. (3,0)3

18.503 GIS in Earth Science

This course introduces students to the technical aspects of geographic information systems, emphasizing operational and cost-effective GIS technologies. Subjects include data requirements and acquisition techniques, hardware/software evaluation, analytic mapping, database processes and human resource requirements for successful GIS implementation. I,II(3,0)3

18.523 Air Resources Management

Air pollutants, their sources, emission rates, ambient concentrations, effects on health, animals and vegetation including aquatic life. The Clean Air Act, National Ambient Air Quality Standards, New Source Performance Standards, Prevention of Significant Deterioration. Exceedances and enforcement. Emission control technologies and strategies. Local, regional and global air resources management. (3,0)3

18.527 Environmental Laws

The large body of law which has developed since the early 1960's is examined in considerable detail. Federal law relating to the environment, particularly with the Environmental Protection Agency and the Occupational Safety and Health Acts. State and local laws and ordinances are discussed where pertinent. (3,0)3

18.568 Environmental Chemistry Laboratory

Wet chemistry and instrumental techniques for the analysis of waters and

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wastewaters. Instrumental methods include atomic absorption spectroscopy, gas chromatography and potentiometric methods. (2,3)3

18.571 Air Pollution Phenomenology

Air pollutants: sources, emission rates, ambient concentrations, dispersion and transport. Photo-oxidant pollutants, particulate matter, acid deposition and global air pollution. (3,0)3

18.572 Energy and the Environment

Flow of energy in our present industrial society from extraction through transport and conversion to end use. Electricity: generation from fossil fuel, nuclear, hydro, solar and other sources. Environmental effects from all sources of energy on a local, regional and global scale. (3,0)3

Civil and Environmental Engineering Industry Advisory Council

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Department of Electrical Engineering

Michael A. Fiddy, Chairperson

Professors: F. Ross Holmstrom, Dikshitulu Kalluri, Venkatarama Krishnan, E. Russell Laste, Samson Mil'shtein, Kanti Prasad, Tenneti K. Rao, Anh Tran, Ziyad Salameh, Charles Thompson, Jay Weitzen, A. David Wunsch

Associate Professors: George P. Cheney, Donn A. Clark, Robert J. Dirkmann, Walter S. Kuklinski, John P. Leonard, Nancy T. Miu, Martin A. Patt, H. James Rome, Gary S. Sales, Stephen J. Spurk, Fahd G. Wakim

Assistant Professors: Kavitha Chandra, Drew A. Pommet

The electrical engineering curriculum provides a thorough grounding in electrical science and engineering, together with an intensive training in mathematics, and emphasizes the techniques of experimental science and technology through investigative laboratory work and class-room lecture-demonstrations. The Electrical Engineering Department strives to be a Department of choice for both local and regional students. We have responded to our ties to industry by offering focused programs both at the undergraduate and graduate level to provide a thinking and technically literate engineer of immediate value to the community. Our graduates are knowledgeable and practical problem solvers, most of whom remain to work in the State.

The Department has 26 faculty, and many technology focus areas that reflect both our strengths. These are Micro- and Optoelectronic Materials, Circuits and Systems, Digital Technology and Computer Engineering, Electromagnetics and Electromagnetic Properties of Materials, Telecommunications and Information Engineering, Electrical Power and Energy Engineering.

The curriculum includes engineering science and design courses that provide a balanced view of hardware, software, application trade-offs and the basic modeling techniques used to represent the computing process, and include the following student experiences: requirements analysis and specification, evaluation and testing, hardware-software integration, use of computer aided design tools and documentation. Such experiences are inte-

grated throughout the curriculum and designed to encourage each student to engage in a major and meaningful design experience. An important aspect of the electrical engineering curriculum is the technical elective program of the senior year. Technical electives provide opportunities for broadening or deepening technical knowledge in a flexible manner and in accordance with student interests and competencies. New tracks with a focus in computing skills as well as double majors in EE and Computer Science and EE and Physics are also offered. The capstone project is organized to bring together knowledge from several courses toward solving a real-world engineering problem. The EE Department has also linked with many local companies, both large and small, in order to offer Co-op opportunities for which course credit can be earned.

A significant portion of the curriculum is also devoted to studies in the humanities and social sciences and considerable choice of subjects is allowed. These subjects broaden the student's outlook and serve to focus attention on the importance of nontechnical knowledge in determining the student's ultimate level of responsibility in professional life.

Students seeking admission into electrical engineering should be familiar with the admission and retention requirements of the College of Engineering. This curriculum is accredited by the Accreditation Board for Engineering and Technology (ABET). All undergraduate students are assigned a faculty advisor and students are encouraged to meet with their advisor during each semester, especially during registration periods or whenever there is some matter of concern.

Course of Study for Electrical Engineering**Freshman Year****Fall Semester**

16.100	Intro to EE I	1
25.107	Intro to Engineering I	2
42.101	College Writing I	3
92.131/33	Calculus I	4
95.141	Physics I	3
96.141	Physics I Lab	1

14

Spring Semester

16.101	Intro to EE II	1
25.108	Intro to Engineering II	2
25.110	Intro to Materials	1
42.102	College Writing II	3
92.132/34	Calculus II	4
95.144	Physics II	3
96.144	Physics II Lab	1
		15

Sophomore Year**Fall Semester**

16.201	Circuit Theory I	3
16.207	Basic EE I Lab	2
16.216	Digital Control Prg.	3
92.231	Calculus III	4
	General Ed Course	3
		15

Spring Semester

16.202	Circuit Theory II	3
16.208	Basic EE II Lab	2
16.217	Microprocomp Oper & Prog	3
16.265	Intro to Logic Design	3
92.234	Differential Equations	3
	General Ed Course	3
		17

Junior Year**Fall Semester**

16.364	Eng. Math	3
16.311	Electronics I Lab	2
16.362	Signals & Systems I	3
16.365	Electronics I	3
25.333	Materials Chemistry	3
45.334	Engineering Values	3
		17

Spring Semester

16.312	Electronics II Lab	2
16.355	Electromechanics	3
16.360	Engg Electromagnetic I	3
16.363	Signals & Sys II	3
16.366	Electronics II	3
		14

Senior Year**Fall Semester**

16.399	Capstone Prop & Comm Skls	3
16.—	Technical Elective	3
16.—	Technical Elective	3
16.461	Engg Electromagnetics II	3
	General Ed Course	3
		15

Spring Semester

16.413	Lin Feedbk Sys/Discr Sys	3
16.499	Capstone project	3
16.—	Technical Elective	3
	General Ed Course	3
	General Ed Course	3
		15

Total credits: 122

Technical Electives should contribute to total number of Engineering Topics credits required.

Computer Engineering Concentration

Beginning with the Fall semester 1994, the Electrical Engineering Department established a concentration in Computer Engineering for undergraduate students anticipating employment with companies that specialize in digital system design and production. The courses offered under this concentration address skills which will be attractive to prospective employers. These courses also provide a basis for continuing education leading to a Master's degree in Computer Engineering. Students who complete the requirements for this concentration will receive a certificate which will be useful in job hunting.

Prerequisites: satisfactory completion of an introductory course in logic design (16.265) and a course in microprocessors and assembly language (16.217).

Concentration requirements: a student meets the requirements for the computer engineering concentration by successfully completing any four of the following courses:

16.465	Logic Design II (1.5 ED)
16.425	Microcontroller Lab (1.5 ED)
16.442	Eng Applications of C++ (1.5 ED)
16.469	VLSI Design (prerequisite 16.365) (3 ED)
16.475	Automated Test Systems (3 ED)
16.499	Capstone Proj. (microproc. or rel proj. topic assumed)(3 ED)
16.501	Discrete Algebras
16.502	VLSI Design (prerequisite 16.365)
16.522	Data Structures
16.524	Programming Languages
16.545	Coding Theory
16.561	Computer Architecture and Design

16.563	Systems Programming
16.574	Advanced Logic Design

Note that students may choose from similar courses to be taken for engineering design (ED) credit or graduate credit. This specifically applies to VLSI Design (16.469 or 16.502) and Logic Design II (16.465 or 16.574). Students should be aware that the prerequisites for the 500 level graduate courses in computer engineering are the same as those for the 400 level computer concentration courses. However, an undergraduate student must have a grade point average of 3.00 or above to take any of the graduate courses.

Computing Foundation**Freshman Year****Fall Semester**

16.100	Intro to EE I	1
25.107	Intro to Engineering I	2
42.101	College Writing I	3
91.101	Computing I	3
91.101.8xx	Computing I Lab	3
92.131	Calculus I	4
		14

Spring Semester

16.101	Intro to EE II	1
25.108	Intro to Engineering II	2
25.110	Intro to Materials	1
42.102	College Writing II	3
91.102	Computing II	3
91.102.8xx	Computing II Lab	1
92.132/34	Calculus II	4
		15

Sophomore Year**Fall Semester**

16.201	Circuit Theory I	3
16.207	Basic EE I Lab	2
91.201	Computing III	4
92.231	Calculus III	4
95.141	Physics I	3
96.141	Physics I Lab	1
		17

Spring Semester

16.202	Circuit Theory II	3
16.208	Basic EE II Lab	2
92.234	Differential Equations	3
92.321	Discrete Structures	3
95.144	Physics II	3
96.144	Physics II Lab	1
		15

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Junior Year

Fall Semester

16.265	Intro to Logic Design	3
16.311	Electronics I Lab	2
16.362	Signals & Systems I	3
16.364	Eng. Math	3
16.365	Electronics I	3
25.333	Materials Chemistry	3
		17

Spring Semester

16.217	Microcomputer Op & Prog	3
16.312	Electronics II Lab	2
16.363	Signals & Systems II OR	3
92.368	Stats for Sci & Engg	
16.366	Electronics II	3
	General Ed Course	3
	General Ed Course	3
		17

Senior Year

Fall Semester

16.360	Electromagnetics I	3
16.399	Capstone Prop & Comm Skls	3
16.4—	Technical Elective	3
45.334	Engineering Values	3
	General Ed Course	3
		15

Spring Semester

16.499	Capstone project	3
16.—	Technical Elective	3
16.—	Technical Elective	3
	General Ed Course	3
	General Ed Course	3
		15

Total minimum credits: 125

Technical Electives should contribute to total number of Engineering Topics credits required.

Computing Concentration

Freshman Year

Fall Semester

16.100	Intro to EE I	1
25.107	Intro to Engineering I	2
42.101	College Writing I	3
91.101	Computing I	3
91.101.8xx	Computing I Lab	3
92.131	Calculus I	4
		14

Spring Semester

16.101	Intro to EE II	1
25.108	Intro to Engineering II	2
25.110	Intro to Materials	1
42.102	College Writing II	3
91.102	Computing II	3
91.102.8xx	Computing II Lab	1
92.132/34	Calculus II	4
		15

Sophomore Year

Fall Semester

16.201	Circuit Theory I	3
16.207	Basic EE I Lab	2
91.201	Computing III	4
92.231	Calculus III	4
95.141	Physics I	3
96.141	Physics I Lab	1
		17

Spring Semester

16.202	Circuit Theory II	3
16.208	Basic EE II Lab	2
16.217	Microcomputer Op & Prog	3
92.234	Differential Equations	3
92.321	Discrete Structures	3
95.144	Physics II	3
96.144	Physics II Lab	1
		18

Junior Year

Fall Semester

16.265	Intro to Logic Design	3
16.311	Electronics I Lab	2
16.362	Signals & Systems I	3
16.365	Electronics I	3
91.305	Computer Architecture	3
		14

Spring Semester

16.312	Electronics II Lab	2
16.363	Signals & Systems II OR	3
92.368	Stats for Sci & Engg	
16.366	Electronics II	3
91.308	Operating Systems	3
	General Ed Course	3
	General Ed Course	3
		17

Senior Year

Fall Semester

16.360	Electromagnetics I	3
16.399	Capstone Prop & Comm Skls	3
25.333	Materials Chemistry	3
45.334	Engineering Values	3
	General Ed Course	3
		15

Spring Semester

16.499	Capstone project	3
91.304	Found of Comp Sci	3
91.404	Analysis of Algorithms	3
	General Ed Course	3
	General Ed Course	3
		15

Total minimum credits = 125

Technical Electives should contribute to total number of Engineering Topics credits required.

Five Year BSEE/MSEE Combined Program

To encourage undergraduate students to continue study toward an advanced degree, the Electrical Engineering Department offers an accelerated program. If all the requirements of the department and of the Graduate School are met the students will receive the BSEE at the end of the fourth year. To complete the work for both degrees within five years, the student must make a commitment to the program before the end of their junior year.

Students in the BSEE/MSEE program should take two 500-level graduate courses in their undergraduate program. Provided that grades in these courses are "B" or better, these courses will count toward the M.S. Degree as well as the B.S. Degree.

A principal benefit of the early identification of academic goals by the student and advisor is a careful structuring of course work that permits the scheduling of prerequisite and required courses in sequence, thus effecting a considerable saving of time.

Students accepted into the program are not required to take Graduate Record Examinations.

Graduate Program

Graduate programs include the degrees of Master of Science in Electrical Engineering and Computer Engineering; the degree programs require three core courses to be taken and are then flexible to permit specialization in one of several concentration areas. M.S. students are strongly encouraged to undertake an M.S. thesis. A master's degree will be awarded upon

satisfactory completion of 30 credit hours of study in the thesis track of which the thesis provides six credit-hours. Thirty-three credit hours

of study are required in the non-thesis track, including the three credit hour seminar course 16.700 or advanced project course 16.733. Students may pursue the Opto-Electronics Option in the M.S. program in Electrical Engineering. The Doctor of Engineering program requires a research dissertation and some additional technical and engineering management courses to be taken. A total of

63 credits are required, of which 21 are thesis credits. The Department also offers several certificate programs at the undergraduate and graduate levels. Certificate programs in several areas such as photonics, telecommunications, VLSI, Energy conversion, communications, and stochastic systems are available.

ELECTRICAL ENGINEERING (Course Prefix: 16)

Undergraduate Courses

16.100 and 16.101 Introduction to Electrical Engineering I & II

This introductory course is designed to expose students to many of the new developments in Electrical Engineering, especially those on-going in the Department. It will also provide information about co-op opportunities and career planning, while also allowing faculty in the Department to describe their courses and answer questions.

16.201 Circuit Theory I

Terminal characteristics of ideal elements, active and passive. Ohm's law and Kirchhoff's Laws. Introduction to network topology, independent variables, loop and nodal analysis with matrix methods. Definition and consequences of linearity. Superposition theorem. Concept of excitation and response. Passive equivalent circuits; active equivalent circuits. Thevenin's and Norton's theorems. Ideal inductance and capacitance, volt-ampere characteristics, energy relations, graphical differentiation and integration. First-order transients: initial conditions, natural response, and natural frequencies. Network response to unit step function and unit impulse. Second-order transients: RLC circuits, natural frequencies and the complex-frequency

s-plane. Engineering Science (100%). Prerequisites: 92.132, 92.134, 95.144. Corequisite: 16.207. II(4,0)3

16.202 Circuit Theory II

Sinusoidal forcing function, complex numbers, phasors, sinusoidal steady-state conditions. Impedance, average power, reactive power and rms values. Exponential forcing function, poles and zeros in the s-plane, concept of the system function and its use in determining the forced response and natural behavior of circuits. Frequency response and resonance, reactance cancellation and concept of s-plane vectors. Thevenin's and Norton's theorems, superposition, reciprocity, and maximum power in the frequency domain. Impedance and admittance and hybrid parameters for a two-port network. Magnetic coupling, mutual inductance, ideal transformer. Engineering Science (100%). Prerequisite: 16.201. Corequisite: 16.208. II(4,0)3

16.207 Basic EE I Laboratory

Experimental work designed to verify theory and to acquaint students with electrical measurement techniques: experiments on meters, bridges, and oscilloscopes. Experiments are correlated with course 16.201 and concern: resistive measurements, Kirchhoff's laws, network theorems, conservation of power and maximum power transfer, inductance and capacitance, and first and second-order transients, operational amplifiers. Engineering Science (50%); Engineering Design (50%). Corequisite: 16.201. I(1,3)2

16.208 Basic EE II Laboratory

Experimental work, designed to emphasize electrical measurement techniques of linear systems with time-varying signals. Waveform measurements with dc and ac meters as well as advanced use of the oscilloscope. Experiments are integrated with course 16.202. Experiments cover: Kirchhoff's laws for phasors, magnitude and phase measurements of impedance, network theorems, frequency response, resonance, inductance, transformers. Engineering Science (50%); Engineering Design (50%). Prerequisite: 16.207. Corequisite: 16.202. II(1,3)2

16.211 Fundamentals of Electricity I

An introduction to direct current and alternating current analysis of electric circuits, with emphasis on energy and power.

Design and use of multirange voltmeters, ammeters, and ohmmeters. Use of bridges and oscilloscopes. Phasor analysis of AC circuits, Trigonometric Fourier series, and BODE plots. Transformers, relays, and solenoids. Mechanical analogs and magnetic analogs with the application of Fourier and BODE techniques. DC and AC motors and generators. Residential circuits, and equipment protection. Introduction to digital logic including minimization techniques. Availability and cost of instruments and components is stressed throughout this course. Not for EE majors. Engineering Science (100%) Prerequisites: 92.132, 92.134. II(3,0)3

16.217 Microprocessors and Assembly Language Programming

Laboratory course with accompanying lectures introducing microprocessor structure and programming. The complete instruction set of a current microprocessor is presented. Topics include binary, decimal, and hexadecimal number systems, ASCII and BCD codes, addressing modes, conditional branching, arithmetic operations, multiple precision, operations on bits, the stack, and subroutines. A floating point subroutine library and monitor routines for communicating with the terminal are exploited, and a number of useful algorithms are presented. Machine language is used prior to introducing assembly language to expose the student to basic internal microprocessor operations. The course terminates with a substantial design project based on an appropriate data structure. Engineering Science (50%); Engineering Design (50%). Prerequisite: 25.106. I,II(2,3)3

16.233 Principles and History of Radio

Intended primarily for students majoring in the liberal arts. The course develops the theory of electricity from an historical perspective. Sufficient background in circuit theory, resonance, field theory and radio waves is given to provide an understanding of the principles of radio from its antecedents in the nineteenth century through the invention of the transistor in the mid twentieth century. The fundamental contributions of, for example Volta, Oersted, Morse, Maxwell, Faraday, Hertz, Lodge, and Marconi are considered. In the present century the technical advances of such figures as DeForest, Fleming, Fessenden, Armstrong and Shockley are studied. The growth, regulation and cul-

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ture of American broadcasting are also central to the course. Some laboratory work is required and students may use this course toward fulfilling the General Education (science/experimental component) requirement of the University. Not open to students in the College of Engineering. Prerequisite: none.

16.265 Logic Design I

Number systems. Boolean algebra, Logic gates and gate conversion. Karnaugh maps. Two-level and multi-level logic. Incompletely specified functions. Multiplexers and decoders/demultiplexers. Latches and flip-flops. Counters. Shift registers. Finite state machines. Two's complement arithmetics. ASM charts. Arithmetic processor. Programmable logic devices. This is an experiment-oriented course. Theories learned in the lectures are applied to the design and building of digital circuits through laboratory experiments. Engineering Science (50%); Engineering Design (50%). Prerequisite: 25.105. I,II(3,3)4

16.267 Logic Design

number systems and binary coded alphanumeric data. Design of combinatorial and sequential binary networks. Simple binary gates such as AND, OR, NAND, NOR, and their interconnection in logic circuits. Boolean algebra. Algebraic, graphical, and logical circuit minimization techniques. Design of sequential circuits such as shift registers and counters. State assignments and state reduction. Design of a simple digital computer. Not for EE Majors. Prerequisite: 95.144. I,II(3,3)4

16.301 Technology for Health Care

An introduction to electrical engineering principles and technology and their direct application to health profession issues. Topics include electrical circuit elements, basic principles of dc and ac circuits, static electricity and electrical isolation issues, transducers and signal conditioning, the distinction between analog and digital signals, D/A and A/D converters, binary numbers, logic operations, microprocessors, microcomputers. A study of some representative medical instruments. Not for EE Majors.

16.311 Electronics I Laboratory

Laboratory experiments coordinated with the subject matter of 16.365. Characteristics and use of electronic instrumentation for making measurements

on electronic circuits. Methods of designing and characterizing diode and transistor circuits. Analysis of performance characteristics of digital and linear semiconductor circuits, including logic elements and amplifiers. Design and construction of circuits using monolithic op amps. Co-requisite: 16.365.

16.312 Electronics II Laboratory

Laboratory experiments coordinated with the subject matter of 16.366. High-frequency characteristics of transistors and transistor amplifiers. Feedback in electronic circuits. Electronic oscillators. Differential amplifiers. Properties of linear IC operational amplifiers and their application in amplifier circuits and waveform generation circuits. Linear circuit design and analysis. Prerequisite: 16.311. Co-requisite: 16.366.

16.315 Complex Variables for Engineers

Complex variables with emphasis on electrical engineering applications. Analytic functions, Cauchy-Riemann conditions. Line integrals, path independence, Cauchy's integral formula and residues. Classification of singularities, branch points and cuts, Taylor and Laurent series. Evaluation of real integrals using residue theory. Principle of the argument, Laplace transforms, Bromwich integral, Nyquist's criterion and stability. Engineering Science (100%). Prerequisites: 92.234 and 16.201. I(3,0)3

16.355 Electromechanics I

Alternating current circuits, three phase circuits, basics of electromagnetic field theory, magnetic circuits, inductance, electromechanical energy conversion. Ideal transformer, iron-core transformer, voltage regulation, efficiency equivalent circuit, and three phase transformers. Induction machine construction, equivalent circuit, torque speed characteristics, and single phase motors. Synchronous machine construction, equivalent circuit, power relationships phasor diagrams, and synchronous motors. Direct current machines construction, types, efficiency, power flow diagram, and external characteristics. Engineering Science (100%). Prerequisites: 16.202 and 95.245. I,II(3,0)3

16.360 Engineering Electromagnetics I

An intermediate course including a review of vector analysis, integration (line, area, volume), and curl, div, grad; electrostatics, magnetostatics, Maxwells' equations, induction and displacement, wave propagation (free space, dielectrics and conductors), reflection from boundaries (normal and oblique incidence). Prerequisites: 92.234, and 16.201

16.362 Signals & Systems I

Introduction to signals and systems. Signal classification: continuous vs. discrete; deterministic vs. random. Normalized energy and power. Signal families, complex exponential, step impulse. Systems: time-domain representation by differential equations; linear time-invariance; classical solution to various signal families; frequency domain representation by system function $H(s)$; total solution of system with initial conditions using $H(s)$. Block-diagram representation of systems and differential equations. Impulse and pulse response of LTI systems. Convolution methods: properties, scanning with impulses, convolution algebra. Fourier series analysis of systems with periodic inputs; properties, spectra and series development with impulse method. Fourier transforms: properties, energy and power signals, response of ideal and non-ideal filters. Nyquist's sampling theorem and its application. Laplace transforms, properties and use, inversion by partial fractions, residues with s-plane vectors, application to LTI systems with initial conditions and sources. Introductions to digital elements and equations. Engineering Science (100%). Prerequisites: 92.234 and 16.202. I,II(3,0)3

16.363 Signals & Systems II

This course employing probabilistic methods of signal and system analysis (an extension of 16.362) considers the random nature of the world faced by electrical engineers. The course addresses the issues of the nature and characterization of random events, especially noise and its effect on systems. The course is divided into three parts, 1) Introduction to discrete and continuous probability 2) Introduction to statistical methods and 3) random signals and noise and the response of linear systems to random signals. There will be frequent use of Monte-Carlo simulation techniques on the computer to allow students to verify theory and to learn the

important technique of simulation.

Applications of theory to manufacturing and reliability, noise analysis, spectral analysis, data communication, data collection, and system design will be presented. Engineering Science (100%). Prerequisite: 16.362. I,II(3,0)3

16.364 Engineering Mathematics

Complex numbers, Argand plane, derivatives of complex numbers, limits and continuity, derivative and Cauchy Riemann conditions, analytic functions, integration in the complex plane, Cauchy's integral formula, infinite series for complex variables, Taylor series, Laurent series, residue theory, evaluation of integrals around indented contours. Linear vector spaces, matrices and determinants, eigenvalues and eigenvectors.

16.365 Electronics I

A brief introduction to solid-state physics, leading to discussion of physical characteristics of p-n junction diodes, bipolar junction transistors, and field-effect transistors: active, saturated, and cut-off models of bipolar transistors and triode, constant current, and cut-off models of MOSFETs. Circuit models for diodes, and diode applications. Circuit models for transistors, and transistor applications in bipolar and MOS digital circuits and low-frequency amplifier circuits. Analysis of digital circuits and linear circuits based on application of circuit models of devices and circuit theory. Engineering Science (100%). Prerequisites: 84.122 and 16.202. Corequisite: 16.311. I(3,0)3

16.366 Electronics II

A continuation of 16.365 with discussion of differential amplifiers, operational amplifiers and op amp applications, transistor amplifiers at very high frequencies; direct-coupled and band pass amplifiers; small and large signal amplifiers; feedback amplifiers and oscillators. Active filters, wave form generation circuits including Schmitt trigger, multiplexers, and A/D and D/A converters. Circuit design employing integrated circuit operational amplifiers and discrete devices. Circuit analysis using SPICE. An electronic design project constitutes a major part of the course. Engineering Science (50%); Engineering Design (50%). Prerequisite 16.365. II(3,0)3

16.367 Microcontroller Programming and Interfacing Laboratory

Laboratory course with accompanying lectures introducing microprocessor programming and interfacing techniques. Topics include microprocessor instruction sets, addressing modes, branching, arrays and stacks, sub-routines, parallel I/O, interrupts, A/D and D/A converters, programmable timers, and interfacing signal sources and loads such as shaft encoders and stepper motors. Two design projects constitute a significant part of the course. Engineering Science (100%); Engineering Design (0%). Not for EE Majors. Prerequisites: 16.217 or 91.203 and 16.265 or 16.267. I(2,3)3

16.399 Capstone Proposal

The purpose of this course is the choosing of a CAPSTONE Project. Students are required to choose from an available list of projects one which most fits their interest. A complete project proposal must be submitted and accepted by the course coordinator and project advisor prior to acceptance into the CAPSTONE course 16.499. Prerequisite 16.366, 16.360, 16.363 (1,0)1

16.401 Digital Signal Processing

Definitions of discrete-time signals and systems, linear shift invariant systems, linear difference equations. Time domain and frequency domain analysis of discrete-time signals and systems: sampling, linear convolution, z-transform. Transform analysis of linear time-invariant systems, filter design techniques, structures for discrete-time systems. Discrete-time Fourier transform, Fast Fourier Transform. Introduction to other topics, as the Hilbert transforms, cepstrum analysis, homomorphic deconvolution, random signals. Application of available computer-aided-design programs to various problems, as frequency analysis, Fourier Transform calculations, and design of filters having different specifications. Engineering Science (50%); Engineering Design (50%). Prerequisite: 16.362. I(3,0)3

16.403 Microwave Design Theory

An introductory course in the analysis and design of passive microwave circuits beginning with a review of time-varying electromagnetic field concepts and transmission lines. Smith Chart problems; single and double stub matching; impedance transformer design; maximally flat and Cheby-chev transformers; microstrip

transmission lines, slot lines, coplanar lines; rectangular and circular waveguides; waveguide windows and their use in impedance matching; design of directional couplers; features of weak and strong couplings; microwave filter design; characteristics of low-pass, high-pass, band-pass, band-stop filter designs; two-port network representation of junctions; Z and Y parameters, ABCD parameters, scattering matrix; microwave measurements; measurement of VSWR, complex impedance, dielectric constant, attenuation, and power. A design project constitutes a major part of the course. Engineering Science (50%); Engineering Design (50%). Prerequisite: 16.461. I,II(3,0)3

16.410 Project Laboratory

The purpose of this course is to provide an opportunity for qualified Electrical Engineering students to investigate specific areas of interest. The actual project undertaken may be software or hardware oriented. The most important characteristics of the projects are that the end results represent independent study and that they are research and development oriented, and that they are accomplished in an engineering environment. Design reviews and progress reports are expected for each project. A final formal report to be permanently filed in the EE Department is required for each project. Engineering Design (100%). Prerequisites: At least three courses from 16.355, 360, 362, 365 and 366. I,II(0,4)3

16.411/412 Directed Studies

The purpose of this course is to allow students the opportunity to work closely with a faculty member or to work on a project of educational value in industry (e.g. on a Co-op internship) and obtain academic credit. A project may be undertaken which can be software or hardware oriented. The end result may represent independent study and be research and development oriented. A final report is expected which will be permanently filed in the EE Department. 16.411 carries 50% Engineering Design and 16.412 none, but both are three credit courses. I,II(0,3)3

16.413 Linear Feedback Systems

Concepts of feedback; open loop and closed loop systems. Feedback in electrical and mechanical systems. Mathematical models of systems and linear approximations. Transfer functions of linear systems, block diagrams and signal flow graphs.

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Sensitivity, control of transient response, disturbance signals. Time domain performance: steady state errors, performance indices. Stability related to s-plane location of the roots of the characteristic equation. Routh-Hurwitz criterion. Graphical analysis techniques: root locus, frequency response as polar plot and Bode diagrams. Closed loop frequency response. A control system design project is included in the course. Engineering Science (50%); Engineering Design (50%). Prerequisites: 16.362 and 16.315. I,II(3,0)3

16.414 Logic Design II

Number systems and codes. Review of switching algebra and combinational logic. Switching networks. Multi-level networks. Multiple-output networks. Minimization by Quine-McClusky (tabular) method. Hazards and hazard-free designs. Review of latches, flip-flops and synchronous sequential networks. Analysis and synthesis of asynchronous sequential networks. Races and essential hazards. Primitive flow tables. Flow table reductions and state assignments. Designs using MSIs. Programmable logic devices: ROMs, PLAs, PALs and PLDs. A design project is required in the course. Prerequisite: 16.265, and 16.217. II(3,0)3

16.416 Amplifiers

An integrated treatment of the analysis and design of electronic amplifiers. Typical amplifier specifications such as noise figure, intermodulation, intercept point, power dissipation, frequency response, gain compression point, and VSWR are discussed in detail. Emphasis is then placed on the choosing of electronic devices and circuit configuration based on amplifier and system design objectives. A design project constitutes a major portion of the course. Engineering Science (50%); Engineering Design (50%). Prerequisite: 16.366. I,II(3,0)3

16.418 Electromagnetics of Wireless Communications

Free space transmission, total path losses, Fresnel zones, terrain and obstruction clearance requirements, effects of diffraction, trees and buildings; atmospheric effects, rain; transmission lines and feed matching problems, broadband and narrow band matching; fading, multipath propagation models, mobile radio communication models, wireless protocols, vhf/uhf amplifiers, communications policy and licenses. Engineering Science (100%). Prerequisite: 16.360. I,II(3,0)3

16.420 Computers in Engineering Analysis and Design

An advanced programming course which considers the digital computer as a tool for solving significant engineering problems. The course is based on a specific area in engineering which will be selected from such topics as digital and image processing, spectral estimation, optimization techniques, etc. Typical algorithms related to the specific topic will be studied. User oriented programs or subroutine packages will be developed in a project. Engineering Design (100%). Prerequisites: 25.127 and senior standing in EE II(3,0)3

16.425 Microcontroller Laboratory

Laboratory course with accompanying lectures introducing microprocessor interfacing concepts and microcontrollers. Topics include interfacing LEDs, switches, keypads, and LCD character displays using parallel I/O ports, interrupts and interrupt systems, A/D and D/A converters, programmable timers and their use in generating and measuring logic signals and controlling motors, serial communications and interfacing with serial devices using the serial peripheral interface. Program development using C. Debugging using a logic analyzer. The course terminates with a substantial project involving the design of a microprocessor controlled system. Engineering Science (50%), Engineering Design (50%) Prerequisite: 16.217 and 16.265 or 16.267 I(2,3)3

16.428 Alternate Energy Sources Photovoltaics

PV conversion, cell efficiency, cell response, systems and applications. Wind Energy conversion systems: Wind and its characteristics; aerodynamic theory of windmills; wind turbines and generators; wind farms; siting of windmills. Other alternative energy sources: Tidal energy, wave energy, ocean thermal energy conversion, geothermal energy, solar thermal power, satellite power, biofuels. Energy storage: Batteries, fuel cells, hydro pump storage, flywheels, compressed air. Course also is listed as 24.528. (3-0)3

16.434 Active Network Theory

A study of active inductorless networks with emphasis on design and implementation. The course will cover the following subjects: approximation theory, the operational amplifier, the gyrator, the negative impedance converter, analysis of basic second-order active building blocks, the

biquad building block, the state-variable filter, and the design of filters. The course includes a detailed design project. Engineering Science (50%); Engineering Design (50%). Prerequisite: 16.366. II(3,0)3

16.439 Introduction to Communication Theory

An introduction to the study of time and frequency domain characteristics of signals arising in communications systems. Fourier analysis, discrete transform, correlation functions, power and energy density spectra. Time and frequency characteristics of thermal noise and random signals in data and noise communications. Spread spectrum concepts. Signal to noise ratio. Amplitude modulation, frequency modulation. Digital modulation, PAM, PCM, bandwidth control, time division multiplexing, transmission of binary data in noise. Engineering Science (100%). Prerequisite: 16.362. I(3,0)3

16.440 Communication Systems

Analysis of the performance and operating characteristics of communication systems from the viewpoint of probability theory. Fundamentals of random processes and discretization of analog signals. Fundamentals of information theory and coding. Optimal Filters. PN coding. Transmission of binary signals in noise (matched filters). Tradeoffs of bandwidth power, and coding complexity in digital transmission. Multiple access digital communications protocols. Applications. Hardware and/or simulation projects. Prerequisite: 16.363. II(3,0)3

16.442 Engineering Applications of C++ Programming Language

This course covers the C++ programming language, programming techniques, program structure, data types including pointers, operators including bit manipulation and I/O methods. Programming assignments will be run on the VAX system and will focus on the uses of arrays, classes and pointers. The emphasis will be on the writing of portable programs that are well organized, readable and work correctly. Applications are chosen from a variety of engineering problems. A design project is required in the course. Engineering Science (50%); Engineering Design (50%). Prerequisite: 16.217. II(3,0)3

16.443 Power Systems Analysis

An intermediate course in analysis and operation of electrical power systems using mathematical techniques including applied calculus and matrix algebra. Topics include network reductions and representation of lines, generators, and transformers, network topology and transform methods. An introduction to protection and relaying is included. Symmetrical components will be introduced with application to polyphase systems. A design project is a major portion of the course. Engineering Science (50%); Engineering Design (50%). Prerequisite: 16.355. II(3,0)3

16.445 Analog Devices & Techniques

A survey of analog devices and techniques, concentrating on operational amplifier design and applications. Operational amplifier design is studied to reveal the limitations of real opamps, and to develop a basis for interpreting their specifications. Representative applications are covered, including: simple amplifiers, differential and instrumentation amplifiers, summers, integrators, active filters, nonlinear circuits, and waveform generation circuits. A design project is required. Engineering Design (100%). Prerequisite: 16.366. I,II(3,0)3

16.460 Computational Electromagnetics II

Formulation of electromagnetic problems for computer solution. Finite difference, finite element, moment, finite difference time-domain methods. Computer solution of several problems of current-interest using available software packages. Prerequisite: 16.360

16.461 Engineering Electromagnetics II

Continuation of Electromagnetic Theory I with emphasis on time varying fields. Faraday's law, induced EMFs, displacement current, Maxwell's equations including the constitutive relationships, propagation of plane waves in both dielectric and conducting media, reflection of plane waves from boundaries between different media, Poynting's theorem, skin depth, transmission line theory, reflection coefficients and standing wave analysis, stub matching and the use of Smith charts for admittance and impedance calculations. Engineering Science (100%). Prerequisites: 16.202, 16.360 and 16.315. I,II(3,0)3

16.462 Antenna Theory and Design

An introduction to properties of individual antennas and arrays of antennas. Retarded potentials, dipoles of arbitrary length, radiation pattern, gain, directivity, radiation resistance. The loop antenna. Effects of the earth. Reciprocity, receiving antennas, effective length and area. Moment methods. Arrays: collinear, broadside, endfire. Array synthesis. Mutual coupling. Log-periodic and Yagi arrays. Radiation from apertures: the waveguide horn antenna, parabolic dish. Antenna noise temperature. Numerical methods. A design project is required in the course. Engineering Science (50%); Engineering Design (50%). Prerequisite: 16.461. II(3,0)3

16.463 Bioelectric Phenomena

This course presents mathematical techniques that provide a quantitative base for a wide range of observed bioelectric phenomena. Specific topics include biological membrane phenomena, the propagating neuron action potential, volume conductor analysis and electrocardiography. Computer projects deal with phase plane analysis of a Hodgkin-Huxley membrane model and the calculation of an equivalent cardiac generator from electro-cardiogram data. Engineering Science (50%) Engineering Design (50%). Prerequisite: 16.360. Corequisite: 16.413. II(3,0)3

16.465 Logic Design II

Number systems and codes. Error detecting and correcting codes. Map-entered variables. Minimization by Quine-McCluskey method. Multiple-output circuits. Timing hazards and hazard-free designs. Analysis and synthesis of synchronous and asynchronous sequential circuits. Races and essential hazards. Primitive flow tables. Flow table reductions and state assignments. Designs using MSIs. Programmable logic devices: ROMs, PLAs, PALs and PLDs. A design project is required in the course. Engineering Science (50%), Engineering Design (50%). Prerequisites: 16.217 and 16.265. II(3,0)3

16.468 Electro-optic Systems

The course is divided into classical optics and modern (quantum) optics. Topics include geometrical and Fourier optics, diffraction and interference, coherence of light, interaction of radiation with matter and polarization states. An introduction to quantum mechanics is given followed by the topics of laser theory and design,

sources and detectors, including semiconductor devices, and nonlinear electro-optics. Engineering Science (100%). Prerequisites: 16.360 and 16.362 or 16.365. I,II(3,0)3

16.469 VLSI Design

MOS devices, CMOS based design of transmission gates, inverters, NAND, NOR and compound gates. Design of multiplexers, memory-latches and registers. CMOS circuits elements, their layout and placement. Switching characteristics, delay, power dissipation, interconnect, reliability and scaling. CMOS layout and performance optimization for clocked and domino logic circuits. Clocking strategies including 2-phase and 4-phase clocking in logic structures. CMOS design methods including hierarchy, regularity, modularity, PLAs and FPGAs. CMOS test methodologies including functionality test, fault models, fault coverage, ATPG, fault simulation and design for testability. Design of ALUs, multipliers, shifters, memory elements, coders and decoders, sense amplifiers and finite state machines. VLSI project is a major part of the course using magic SPICE and ESIM etc. and will be fabricated at MOSIS. Engineering Design (100%) Prerequisites: 16.265 and 16.365. I,II(3,0)3

16.470 VLSI Fabrication

Fabrication of resistors, capacitors, p-n junction and Schottky barrier diodes, BJT's and MOS devices and Integrated circuits. Topics include: silicon structure, wafer preparation, sequential techniques in micro-electronic processing, testing and packaging, yield and clean room environments. Modeling of yield mechanisms, distribution of defects, MTBF, accelerated testing and reliability requirement for VLSI. MOS structures, crystal defects, Fick's laws of diffusion; oxidation of silicon, photolithography including photore-sist, development and stripping. Metallization for conductors, Ion implantation for depletion mode and CMOS transistors for better yield speed, low power dissipation and reliability. Introduction to GaAs, VHSIC, and MMIC technologies with emphasis on parametric characterization. Students will fabricate circuits using the DSIPL Laboratory. Engineering Design (100%). Prerequisite: 16.365. I,II(3,0)

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16.473 Power Electronics

A one-semester course with emphasis on the engineering design and performance analysis of power electronics converters. Topics include: power electronics devices (power MOSFETs, power transistors, diodes, silicon controlled rectifiers SCRs, TRIACs, DIACs and Power Darlington Transistors), rectifiers, inverters, ac voltage controllers, dc choppers, cycloconverters, and power supplies. The course includes a project, which requires that the student design and build one of the power electronics converters. A demonstrative laboratory to expose the students to all kinds of projects is part of the course. Engineering Design (100%). Prerequisites: 16.355, 16.366. I(3,0)3

16.474 Principles of Solid-State Devices

Principles of Solid State Devices: Crystal properties and growth of semi-conductors, atoms and electrons, Bohr's model, quantum mechanics, bonding forces and energy bands in solids, charge carriers in semiconductors, drift of carriers in electric and magnetic fields, carrier lifetime and photoconductivity, junctions, forward and reverse bias, reverse bias breakdown (Zener effect), tunnel diodes, photodiodes, LED, bipolar junction transistors, field effect transistors. A design project is included in the course. Engineering Science (50%); Engineering Design (50%). Prerequisite: 16.365. II(3,0)3

16.475 Automated Test Systems

A design-oriented introduction to the techniques of modern automatic test systems, covering both hardware and software. Topics include: automated testing in engineering and manufacturing; the IEEE-488 instrument bus; programmable test equipment; the device under test interface; modular software development; and human engineering and ethical considerations. The course includes a project in which students develop a complete automated test system for some real device. Student designs are implemented in the EE department's Automated Test System Laboratory. During the project students maintain project schedules and conduct design reviews to critique each other's designs. Completed projects are demonstrated and thoroughly documented. Engineering Design (100%). Prerequisites: 16.366 and 25.101. I,II(3,0)3

16.490 Fiber Optic Communications and Networks

Optical fiber; waveguide modes, multi-mode vs single mode; bandwidth and data rates; fiber losses; splices, couplers, connectors, taps and gratings; optical transmitters; optical receivers; high speed optoelectronic devices; optical link design; broadband switching; single wavelength systems (FDDI, SONET, ATM); coherent transmission; wavelength division multiplexing and CDMA; fiber amplifiers. Prerequisites: 16.360, 16.362 or permission of instructor.

16.499 Capstone Project

The purpose of the CAPSTONE Project is to provide the student with a design experience which resembles entry level engineering assignments. It is expected that the project encompass a minimum of three technical areas within the EE discipline, and include some aspects of each step in the development of a marketable product i.e. Research, Design & Development, Manufacture, Marketing & Service. A formal technical report must be submitted prior to the submission of a course grade. Engineering Design (100%) Prerequisite 16.399. I,II(0,3)3

Primarily for Graduate Students**16.500 Comprehensive Study of EE**

This course is designed to help those students who have been out of academia for a while and who are preparing for the doctoral qualifying examinations.

16.501 Discrete Algebras

A comprehensive course addressing the diversity of discrete algebraic systems needed in digital system synthesis and analysis. Review of sets, mappings, functions and relations. Abstract algebraic systems including lattices, groups, rings and discrete fields. Combinatorial analysis, event space algebra, solution of difference equations, discrete limits and complexity functions, elementary discrete and concrete functions. Prerequisites: Calculus and Laplace Transforms. (3,0)3

16.502 VLSI Design

MOS devices, CMOS based design of transmission gates, inverters, NAND, NOR and compound gates. Design of multiplexers, memory-latches and registers. CMOS

circuits elements, their layout and placement. Switching characteristics, delay, power dissipation, interconnect, reliability and scaling. CMOS layout and performance optimization for clocked and domino logic circuits. Clocking strategies including 2-phase and 4-phase clocking in logic structures. CMOS design methods including hierarchy, regularity, modularity, PLAs and FPGAs. CMOS test methodologies including functionality test, fault models, fault coverage, ATPG, fault simulation and design for testability. Design of ALUs, multipliers, shifters, memory elements, coders and decoders, sense amplifiers and finite state machines. VLSI project is a major part of the course using magic SPICE and ESIM etc. and will be fabricated at MOSIS. Prerequisites: 16.265 and 16.365. I,II(3,0)3

16.503 Solid-State Physical Electronics I

Introduction to the behavior of solid state devices. Review the Bohr model of the atom, wave-particle duality, wave packets and Schroedinger's equation. Study of crystalline and amorphous materials. Band theory of solids; electrons and holes. Metals, insulators and semiconductors. Semi-conductor behavior. Prerequisite: 16.360 or consent of the instructor. (3,0)3

16.504 VLSI Fabrication

Fabrication of resistors, capacitors, p-n junction and Schottky barrier diodes, BJT's and MOS devices and Integrated circuits. Topics include: silicon structure, wafer preparation, sequential techniques in micro-electronic processing, testing and packaging, yield and clean room environments. Modeling of yield mechanisms, distribution of defects, MTBF, accelerated testing and reliability requirement for VLSI. MOS structures, crystal defects, Fick's laws of diffusion; oxidation of silicon, photolithography including photore-sist, development and stripping. Metallization for conductors, Ion implantation for depletion mode and CMOS transistors for better yield speed, low power dissipation and reliability. Introduction to GaAs, VHSIC, and MMIC technologies with emphasis on parametric characterization. Students will fabricate circuits using the DSIP Laboratory. Prerequisite: 16.365. I,II(3,0)3

16.505 Microwave Electronics

Review of p-n junction theory; PIN diodes and their applications in switches, phase shifters and attenuators; Schottky barrier diodes, varactors and step recovery diodes; multiplier design; tunnel diodes and their applications in amplifiers and oscillators; Gunn diodes and impact diodes and circuit applications; microwave transistors and design of amplifier circuits using S-parameter description; field effect devices and circuits; microwave tubes including two-cavity and reflex klystrons, travelling wave tubes and magnetrons. Prerequisites: 16.461. (3,0)3

16.506 Antenna Theory and Design

Introduction to the fundamental principles of antenna theory: analysis, synthesis and design. Antenna parameters. Electromagnetic fields due to prescribed sources; near and far regions; reciprocity. Infinitesimal dipole. Arrays (patterns, mutual coupling). Array synthesis. Linear wire dipole, loop, traveling wave, frequency independent, aperture and horn antennas. Noise considerations, numerical methods. Prerequisite: 16.461 or permission of instructor. (3,0)3

16.507 Electromagnetics

Maxwell's equations and boundary conditions. Electric and magnetic potentials. Static approximations, boundary value problems and solutions by separation of variable technique. Plane waves, dispersion, polarization, reflection and refraction. Guided waves, transmission lines and wave-guides. Cavity resonators. Optical Applications. Prerequisite: 16.461. (3,0)3

16.508 Quantum Electronics for Engineers

Introduction to the fundamental postulates of quantum theory: Planck's quantization hypothesis; wave-particle duality; time-dependent & time-independent Schrodinger's Equation; simple quantum mechanical systems. Radiation and quanta; quantization of the radiation field and cavity modes; absorption and emission of radiation; coherence functions; coherent states; importance of quantum fluctuations and quantum nature of light; laser amplifiers and amplifier nonlinearity; electromagnetics and quantum theory of laser oscillators; photons in semiconductors; semiconductor photon sources and detectors.

16.509 Linear Systems Analysis

Fourier series and transforms. Hilbert transforms and analytic signals. Bilateral Laplace transforms. Contour integration methods. Correlation and Circular convolutions. Concepts of orthogonality and Gram-Schmidt orthogonalization procedure. Discrete-time Fourier series and transforms including complex convolution. Z-transforms and solution of difference equations. Applications to linear systems including modulation, sampling and filtering. Prerequisite: 16.362. (3,0)3

16.510 Digital Signal Processing

Review of Z-Transforms and solutions of linear difference equations. Digital filter structures, parameter quantization effects and design techniques. FFT and Chirp Z-Transform methods. Discrete Hilbert Transforms, minimum-phase sequences and their application to Homomorphic Signal Processing and calculation of Complex Cepstrum. Prerequisite: 16.509. (3,0)3

16.511 Digital Image Processing

Introduction to the analytical principles and methods of image representation and image processing; a series of computer projects that demonstrate these principles. Image sampling, image transforms, image enhancement and image data compression techniques; implementation of image processing algorithms based on fractal image models. Prerequisite: 16.510 or permission of instructor.

16.512 Electronic Materials I

Introduction to types of electronic materials, including semiconducting, optical, superconducting, and magnetic materials. Material quality vs. device performance. Defects such as point defects, dislocations, phase boundaries, and second phases, and their electronic effects. The phase rule, phase diagrams, and thermodynamics. Introduction to crystallography. Physical basis for quantum behavior in solid state devices. Bulk and thin film materials preparation - starting materials, crystal growth, and control requirements. Each student will undertake an individual project reviewing preparation methods for a material of industrial or research importance.

16.513 Modern Control Theory

State-variable representation and analysis of linear systems. Controllability and observability. Representation of nonlinear

systems. State functions of Lagrange, Liapunov and Pontryagin. Stability. Optimality and variational calculus. State-function approach to linear system synthesis and control. Time domain design of continuous and discrete time systems. Prerequisites: 16.362 or 16.509. (3,0)3

16.514 Power Systems Analysis

An intermediate course in analysis and operation of electrical power systems using mathematical techniques including applied calculus and matrix algebra. Topics include network reductions and representation of lines, generators, and transformers, network topology and transform methods. An introduction to protection and relaying is included. Symmetrical components will be introduced with application to polyphase systems. Prerequisite: 16.355 (3,0)3

16.515 Power Electronics

Design and performance analysis of rectifiers, inverters, DC chopper, AC voltage controllers, cycloconverters, and power supplies. The course includes a design project in the laboratory. Prerequisites: 16.355 and 16.366. (3,0)3

16.516 Advanced Machine Theory

Electromechanical energy conversion. Reference-frame theory. Dynamics of DC, induction, and synchronous machines. Unbalanced operation of induction and synchronous machines. Prerequisites: 16.355. (3,0)3

16.518 Electromagnetics of Materials for Optical Engineering

Part A: Metal Optics; Interaction of light with metal surfaces and excitation of longitudinal plasma waves inside the metal; Hydrodynamic approximation and waves in a warm plasma; Boundary conditions at a free surface; Boundary conditions at an interface between two metals of different electron densities; Reflection, transmission and resonances in thin metal films; The surface plasmon dispersion; Electromagnetic spectra at silver surfaces; Ellipsometry from metal surfaces; Resonances in small metal spheres. Part B: Dielectric Optics; Origins of light/electromagnetic scattering in dielectrics; Validity of (Kramers Kronig) dispersion relations for dielectric permittivity; The theory of dielectrics and anisotropic media; Foundations of the macroscopic electromagnetic theory of dielectrics; Optical susceptibility (linear and nonlinear); Physical

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origin of nonlinear permittivities, including quantum confinement effects in nanostructures; Wave mixing and harmonic generation; Electrostriction and radiation pressure; Artificial linear and nonlinear media; Speed/power trade-offs in dielectric responses.

16.520 Computer Aided Engineering Analysis

Numerical linear algebra: eigenvectors and eigenvalues; LU, QR, Singular Value Decomposition, least squares. Numerical solution of partial and ordinary differential equations: method of weighted residuals, spectral methods, finite difference and finite element methods. Time differencing and stability. Approximation theory. Discrete-event simulation. Computer graphics. Prerequisite: 92.234. (3,0)3

16.522 Data Structures

This course uses the object-oriented approach provided by the C++ programming language to solve problems involving complex data storage structures. Topics included are static and dynamic arrays, sorting and searching of data, external file operations, recursion, dynamic data structures such as lists, trees and graphs. Prerequisites: Pascal or C or instructor's permission. (3,0)3

16.524 Programming Languages

Syntax and semantics of programming languages. Fundamental concepts of control structures, modularity, scope of identifiers, recursion, and data structures. Examples of real programming languages such as FORTRAN-77, Pascal, LISP, APL, C and ADA. Prerequisite: FORTRAN or Pascal. (3,0)3

16.525 Simulation Techniques

A study of techniques for the simulation of continuous and discrete time systems and processes. Deterministic and stochastic systems. Model building, simulation organization, statistical consideration and model validation. Prerequisites: 16.520, 16.366. (3,0)3

16.528 Alternate Energy Sources

Photovoltaics: PV conversion, cell efficiency, cell response, systems and applications. Wind energy conversion systems: Wind and its characteristics; aerodynamic theory of windmills; wind turbines and generators; wind farms; siting of windmills. Other alternative energy sources: Tidal energy, wave energy, ocean thermal

energy conversion, geothermal energy, solar thermal power, satellite power, biofuels. Energy storage: Batteries, fuel cells, hydro pump storage, flywheels, compressed air. Course also is listed as 24.528.

16.532 Computational Electromagnetics

Formulation of electromagnetic problems for computer solution. Variational principles in electromagnetics. Green's function, Method of moments. Applications in electrostatics, wire antennas, waveguides and cavities. Simple scattering problems. Finite difference methods. Finite element method. Prerequisite: 16.461. (3,0)3

16.533 Microwave Engineering

Principles of guided wave propagation; rectangular and circular waveguides; TEM and Quasi-TEM lines including coaxial line, strip line, microstrip line, slot line and coplanar lines; impedance matching including single and double stub matching, lumped element matching; quarter-wave transformer designs with binomial and chebyshev characteristics; two-part network representation of microwave circuits; Z, Y, ABCD and scattering matrices; filter designs with low pass, high pass and bandpass characteristics; waveguide and microstrip resonators; directional couplers and design features for weak and strong coupling; microwave ferrites and components microwave measurements techniques. Prerequisites: 16.461. (3,0)3

16.543 Introduction to Communication Theory

Information transmission and deterministic signals in time and frequency domains. Relationship between correlation and power or energy spectra. Statistical properties of noise. Spectral analysis and design of AM, FM and pulse modulation systems, continuous and discrete. AM, FM, and various pulse modulation methods, in the presence of noise. Digital modulation & demodulation technique. Prerequisites: 16.362 16.363 or 16.584 or equivalent.

16.544 Theory of Communication II

This course presents advanced topics in modern communication not covered in other courses. It is oriented towards applied modern digital communication and telecommunications. Topics include: Convolutional Coding and Decoding using the Viterbi Algorithm. Trellis code modulation for bandwidth and signal limited channels. Ungerboeck set partitioning,

Spread Spectrum and applications to personal communication systems, Discrete Multi-tone modulation for dispersive channels, DSP based implementation of advanced modulation, Characterization of communication channels and design of signals. Prerequisite: 16.543 or permission of instructor.

16.545 Coding Theory

Concepts and recent developments in the use of codes for error control in data handling systems. Encoding and decoding procedures and their implementation in computational algorithms and hardware organizations are investigated in detail. Prerequisite: permission of instructor. (3,0)3

16.548 Information Theory

Probabilistic measure of information. Determination of the information handling capacity of communication channels and fundamental coding theorems. Introduction to information coding and error correcting codes. Prerequisite: 16.363 or 92.386 or equivalent. (3,0)3

16.555 Applications of microwaves and lasers in medicine

Microwave hyperthermia, implantable radiators and techniques; EM techniques for medical diagnostics: lung water measurement, blood flow measurements, arterial wall movement by microwave Doppler radar, microwave radiometry and its uses in breast cancer; RF-field interactions with biological systems: electrical properties and biophysical mechanisms; introduction to medical optics and lasers: laser characteristics, laser surgery, optical fiber delivery systems, endoscopes, optical fiber sensors and spectrometers, phototherapy, photon migration and imaging through tissue, coherence tomography, biometrics, ophthalmic applications, laser tweezers

16.561 Computer Organization and Design

Structure of computers, past and present: first, second, third and fourth generation. Combinatorial and sequential circuits. Programmable logic arrays. Processor design: information formats, instruction formats, arithmetic operations and parallel processing. Hardwired and microprogrammed control units. Virtual, sequential and cache memories. Input-output systems, communication and bus control. Multiple CPU systems. Prerequisites: 16.217, 16.265. (3,0)3

16.563 System Programming

This course covers C++ programming and assembly language programming and to integrate program modules of both types to solve a wide variety of problems. The topics covered include recursion, push-down stacks and queues, re-entrant interrupt programming, serial data communication programming and TSR programs. Prerequisite: 16.217. (3,0)3

16.565 Analog Devices & Techniques

A survey of analog devices and techniques, concentrating on operational amplifier design and applications. Operational amplifier design is studied to reveal the limitations of real op-amps, and to develop a basis for interpreting their specifications. Representative applications are covered, including: simple amplifiers, differential and instrumentation amplifiers, summers, integrators, active filters, nonlinear circuits, and waveform generation circuits. A design project is required. Prerequisite: 16.366

16.568 Electro-optic Systems

Geometric and Fourier optics, coherence, fiber optics, resonators, interaction of radiation with matter, laser theory and design, radiation detection, nonlinear optics and light modulation. Prerequisite: 16.360. (3,0)3

16.569 Electro-optics and Infrared Systems

Introduction to optoelectronics and laser safety; ir sources and blackbodies, characterization of sources, ir signatures and camouflage, geometrical optics; waves and polarization; optical alignment techniques, diffraction, Fourier optics; coherence of light; elementary quantum concepts and photon emission processes; optical resonators; laser theory and types; review of semiconductor lasers and detectors; optical design for ir imaging, testing ir systems, focal plane arrays. Prerequisite: 16.360.

16.570 Solar Cells - Design, Technology and Applications

Economy of solar cell energy conversion, electrical and optical properties of semiconductors, operation of pn junction, design of solar cells and solar cell manufacturing. Solar cells for individual customers, utility networks, the military and space. Mid term design project and laboratory measurements required.

16.571 Radar Systems

Introduction to both pulsed and C. W. radar systems. Detection of radar echoes in noise. The radar equation and its use in estimating performance of a radar system. Estimation of range, direction and velocity of targets. Moving target indicators (MTI). Pulse compression and other advanced techniques. Discussion of elements of practical radar systems. Prerequisite: 16.461. (3,0)3

16.574 Advanced Logic Design

Geometric representation of binary numbers. Switch networks. Reed-Muller polynomials. Minimization by Quine-McCluskey (tabular) method. Transient analysis of hazards and hazard-free design. Special properties of switching algebra: symmetric functions,unate functions, threshold functions, Boolean difference and decomposition. Analysis of fundamental-mode and pulse-mode sequential circuits. Sequential circuit synthesis. Programmable logic devices. Test sets and design for testability. Prerequisites: 16.217, 16.265, 16.365. (3,0)3

16.582 Radio Frequency Communication System Design

Study of radio wave propagation. Factors affecting the performance of terrestrial line-of-sight microwave radio systems and cellular mobile radio systems. Design and field operation of QAM digital radio systems. Computation of statistics of system performance including availability and errors. Prerequisite: 16.461. (3,0)3

16.583 Wave Propagation in Plasmas

Plasma waves and the interaction of electromagnetic radiation with plasmas, specifically the earth's ionosphere. Refraction, reflection, dispersion, absorption, and ray paths. Ionospheric effects on ground-to-ground and ground-to-satellite radio and over-the-horizon radar systems. Review of ionospheric physics. Prerequisite: 16.461. (3,0)3

16.584 Probability and Random Processes

Sample space, Field and Probability Measure. Axiomatic definition of Probability. Bayes' theorem. Repeated trials. Continuous and discrete random variables and their probability distribution and density functions. Functions of random variables and their distribution and density functions. Expectation, variance

and higher order moments. Characteristic and generating functions. Vector formulation of random variables and their parameters. Mean square estimation and orthogonality principle. Criteria for estimators. Introduction to random processes: distribution and density functions; ensemble and time averages; correlation functions and spectral densities. Classification of random processes. Random processes through linear systems. Weiner filters and Kalman filters. Prerequisite: 16.362. Corequisite: 16.509. (3,0)3

16.590 Fiber Optic Communications and Networks

Optical fiber; waveguide modes, multi-mode vs single mode; bandwidth and data rates; fiber losses; splices, couplers, connectors, taps and gratings; optical transmitters; optical receivers; high speed optoelectronic devices; optical link design; broadband switching; single wavelength systems (FDDI, SONET, ATM); coherent transmission; wavelength division multiplexing and CDMA; fiber amplifiers. Prerequisites: 16.360, 16.362 or permission of instructor.

16.602 Advanced VLSI Design

Modeling of first- and second-order phenomena in MOS transistors as applied to interconnection, time response, power dissipation and test methodologies for CMOS technology. Exhaustive analysis of design rules as applied to layout and placement of ASICs. Implementation of data paths, control structures, and gate arrays with specific design methodologies as applied to fuzzy controllers, communication circuits, DSP based processors, protocol engines wireless modems, RISC processors, SRAMS, DRAMS and VHDL, cells along with exhaustive testing techniques. Students will test the chip fabricated in 16.469/16.502 project using VLSI Tester. Students will design elaborate systems and test them exhaustively using CAD and simulation tools in VLSI Design Laboratory. These designs will be sent for fabrication at MOSIS. Prerequisite: 16.502. (3,0)3

16.603 Solid-State Physical Electronics II

Semiconductor devices: Schottky diodes. P-n junction devices. Junction transistors. FETs. Photodiodes. Varactors. Electro-optic devices, thermo-electric devices, electro-luminescent diodes and laser diodes. Prerequisite: 16.503. (3,0)3

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16.605 Defects in Semiconductor Device Technology

Thermodynamics of defect generation, mechanisms of their interaction and movement. The generation of point defects, dislocations, two dimensional defects specifically during every technological step, such as wafering, oxidation, diffusion, epitaxy, etc. Influence of dislocations and point defects on electrical and optical properties of silicon and compound semiconductor devices. Techniques for reduction of defects in device fabrication technology. Prerequisite: permission of instructor. (3,0)3

16.607 Electromagnetics of Complex Media

Electromagnetic waves interactions with complex media are the basis of many modern and emerging technologies in optical, plasma and microwave engineering. Wave propagation in chiral, magnetoplasma, ferrite, moving, time-varying, inhomogeneous and periodic media. Surface waves. Prerequisite: 16.507 or permission of instructor.

16.608 Scattering and Diffraction of EM Waves

Review of EM Theory. Scattering from a long cylinder for TM and TE waves. Scattering pattern and cross section. Scattering from a sphere. Rayleigh and Mie regions. Half-plane and wedge diffraction. GTD and applications for high frequency scattering. Babinet's principle and diffraction by an aperture. Physical theory of diffraction. Wiener-Hopf methods. Prerequisite: 16.507. (3,0)3

16.610 Optics for Information Processing

Rigorous treatment of diffraction theory and Fourier optics; coherence theory and interferometry; analog Fourier computing; holographic filters; nonlinear optical phenomena; spatial light modulation; photorefractive memories and phase conjugation; digital optical processors and optical interconnects; optical neural networks; current and future trends in optical computing. Prerequisite: permission of instructor. (3,0)3

16.611 Solar Terrestrial Relations

Overview of solar terrestrial relations with emphasis on morphology, related electromagnetic theories and a study of quiescent and disturbed states. Topics include: solar physics, interplanetary medium, the geo-

magnetic field and magnetospheric physics. It is planned that each student select one topic for independent study to assess observational techniques or relevant theories. Prerequisite: permission of instructor. (3,0)3

16.613 Nonlinear Systems Analysis

Methods of analysis for nonlinear and chaotic systems. Approximation methods for ordinary and partial non-linear differential equations. Stability and the methods of Lyapunov. Regular and singular perturbation methods. Lindstedt-Poincare method. Method of Multiple Scales. Method of Averaging and harmonic balance. Conservative and nonconservative systems. Parametrically excited systems. Prerequisite: 16.520. (3,0)3

16.614 Optimal Control Theory

Deterministic optimal control systems. Performance measures for optimal systems. Dynamic programming and related computer techniques. Discrete linear regulator. The Hamilton-Jacobi-Bellman equation. Continuous linear regulator. Calculus of variations and Pontryagin's minimum principle. Minimum time problems. Minimum effort problems. Prerequisites: 16.509 and 16.513. (3,0)3

16.615 Solid State Drive Systems

Elements of variable speed drive systems. Rectifier and chopper control of DC drives. Control of induction motors by AC voltage controllers. Frequency-controlled induction motor drives. Slip-power controlled wound-rotor induction motor drives. Synchronous motor speed control. Prerequisites: 16.515. (3,0)3

16.616 Computational Power System Analysis

Power system matrices, power flow studies, fault studies, state estimation, optimal power dispatch, and stability studies. Prerequisites: 16.443 and 16.520. (3,0)3

16.617 Modeling and Simulation Techniques for Communication Networks

Overview of general architectures for B-ISDN and Internet, network layering, signalling, performance requirements, traffic management strategies, usage parameter control, connection admission control, congestion control, stochastic processes, Markov chains and processes, stochastic models for voice, video and data traffic, Poisson processes, Markov-modulated

processes, traffic analysis, queueing systems, M/M/1, M/M/m, M/G/1 queues, fluid buffer models, effective bandwidth approaches, simulation modeling, discrete event simulation of transport and multiplexing protocols using OPNET software, statistical techniques for validation and sensitivity analysis.

16.619 Digital Control Systems

Discrete-time systems. Sampling and reconstruction of signals. Z-transform. Output and state feedback. Stability. Pole assignment and design of digital controllers. State estimation. Introduction to Kalman filters. Prerequisites: 16.510 and 16.513. (3,0)3

16.661 Computer and Local Area Networking

Characteristics and topology of Local Area Networks (LANs), WANS and MANs. Design of cable plants based on coaxial as well as fiber optic technologies. Data communication including transmission, reception, bandwidth, error correction and detection. Data flow in networks and queueing theories. G/M/1 model, M/D/1 model and priority. circuit switched networks including data switches, blocking analysis, sizing of PBXs. Network structures, access techniques and performance measures. Access protocols including ALOHA, slotted ALOHA and CSMA/CD. Central control and basic capacity. Polling networks including their analysis, delay and performance. Topologies such as star, ring, bus and basic operations based on token rings and slotted rings. Random access networks and their analysis pertaining to CSMA/CD, slotted ALOHA, contention and congestion control. Prerequisite: 16.561 or 16.563. (3,0)3

16.662 Microprogramming

Horizontal and vertical microprogramming structures including finite state machine controllers. Implementation of digital functions as firmware on microprocessors. Register transfer assemblers. State partitioning and optimization. Micro-instruction set design and design of microprogrammed data paths. Prerequisites: 16.561, 16.574. (3,0)3

16.663 Compiler Structures

Translators and interpreters for programming languages. Syntax of programming languages; syntax directed compilation. Parsing techniques: operator precedence, top down, bottom up and reductive strate-

gies. Generation and optimization of machine code. Error handling: detection and correction. The run time environment, storage allocation. Prerequisite: 16.563. (3,0)3

16.664 Parallel Processing

Supercomputer organization, architectures and application algorithms. Vector and concurrent optimization. Performance analysis. Synchronous and asynchronous algorithms. Multiple pipeline, bus, and switch based multiple processor systems. Multi-level cache and multi-dimensional access memory structures. Current research and production parallel processing computers. Prerequisites: 16.563 and 16.561. (3,0)3

16.665 Digital Function Analysis

Theoretical aspects of digital systems from a mathematical perspective. The theories of switching, automata and formal languages are developed as the basis for the discussion of the theories of computability and computational complexity. Extensive analysis is given to the most common functions that occur in digital systems including arithmetic and controller structures. Prerequisite: 16.501, 16.412 or 16.574. (3,0)3

16.667 Operating Systems

Scheduling and communication of the resources of large computer systems. Sequential and concurrent processes allowing program sharing, multi programming, multi-processing, memory sharing and protection. Paging, segmentation and swapping strategies. Time sharing and multiple-task operating systems. Design and simulation of operating system behavior. Prerequisite: 16.563. (3,0)3

16.671 Advanced Computer Architecture

Architectural analysis of high performance single processor and systolic processor systems. Memory structure optimization, pipeline control and high-speed arithmetic structures. Cost and performance of switch-based multiple processor systems. Analysis of alternative architectures including associative array and data flow machines. Prerequisite: 16.561. (3,0)3

16.674 Digital Processor Design

Algorithms at the register transfer level; cost and performance tradeoffs with decomposition and optimization. Design of complex digital structures using large

scale integrated and semi-custom devices. Detailed timing analysis of processor interface busses and memory subsystems. Use of special purpose microprocessors to realize digital systems. Prerequisite: 16.574. (2,2)3

16.675 Advanced Digital Devices

State of the art microprocessors are examined and compared to their eight bit counterparts. The four architectural concepts of memory segmentation, operated addressing structure, operation register set, and instruction encoding scheme are evaluated for different families of processor design. Arithmetic and logical instruction support for high performance numeric processing requirements are discussed using numeric data processors. Prerequisite: 16.674. (3,0)3

16.676 Digital Design Laboratory

Brief introduction to C. Application of digital devices and systems to realistic engineering problems. Design, development, construction, and testing of systems emphasizing state-of-the-art digital design methodologies. Enrollment limited; extensive time in laboratory required. Prerequisite: 16.674. (0,3)3

16.684 Time Series Analysis & Forecasting With Applications

Review of Estimation of Stochastic processes: Estimation of mean, variance, autocovariance, autocorrelation and normalized autocovariance of discrete stochastic processes; Generation of White Noise Sequences and tests for white noise; Difference operations. Linear Stationary models: Autoregressive (AR) processes, Yule-Walker equations, partial correlation. Moving Average (MA) processes, invertibility conditions and solution for MA parameters; Relation between AR and MA processes; Autoregressive Moving Average (ARMA) processes, formulation and solution for ARMA parameters. Levinson-Durbin & related algorithms; Deterministic and Probabilistic Methods; Forward-Backward Prediction; Lattice Methods. Gram-Schmidt Orthogonalization method; Burg Algorithm. Linear nonstationary Models: Autoregressive Integrated moving Average processes, differencing to induce stationarity and determination of the order of differencing. Model Identification and Diagnostic Checking: Examples for model identification; Portmanteau test and other tests for residuals to check for white noise.

forecasting: Several methods for forecasting; Box-Jenkins forecasting functions, three types; Examples for the three types of forecasting; One-step linear predictors and confidence limits. Seasonal Time Series: Formulation of seasonal time series models and basic ideas of forecasting.

16.685 Statistical Communication Theory

Review of probability and random variables. Random processes; statistics of white noise; Fourier analysis of periodic random processes; Karhunen-Loeve expansion; narrow-band Gaussian processes; linear systems. Discrete-time and continuous-time matched filters; spectral factorization and solution of integral equations. Maximum likelihood receivers. Digital modulation. Information theory: entropy, ratio distortion theory, channel capacity, and introduction to coding. Prerequisite: 16.509 and 16.584 or permission of instructor. (3,0)3

16.687 Applied Stochastic Estimation

Review of random processes and key elements of probability theory. State space description of systems and random processes, relation to frequency domain techniques. Numerical methods of continuous and discrete time random system modeling. Optimal Kalman filtering for discrete and continuous random systems. Sensitivity analysis. Design considerations in the face of model uncertainty, numerical instabilities, bad data. Optimal smoothing. Non linear filtering. Parameter identification. Applications throughout. Prerequisite: 16.584.

16.700 Seminar

Development, preparation, and written and oral presentation of a report on an advanced engineering topic: Oral presentation of proposals; modification and redefinition as required; oral presentation to the class and instructor of results of investigation; submission of final written report. Grade based on clarity of exposition, knowledge of subject, ability to clearly and effectively answer questions, and participation in the discussion of other papers. Class size limited to ten students. Prerequisite: minimum of 15 credit hours of graduate courses: for students in the non-thesis option only. (3,0)3

COLLEGE OF ENGINEERING*Department of Mechanical Engineering***16.733 Advanced Project**

The Advanced Project is a substantial investigation of a research topic under the supervision of a faculty member. A written proposal must be on file in the Electrical Engineering Graduate Office before enrollment. A written report is required upon completion of the project. This course can be taken only once, and may evolve into a master's thesis. However, credit for this course will not be given if thesis credit is received. (0,6)3

16.743 Master's Thesis Research(0,6)3**16.746 Master's Thesis Research**

Corequisites: Minimum of six credit-hours of graduate courses at an acceptable level when registering for first three credits and 12 credit hours when registering for subsequent credits; approval of a written proposal outlining the extent and nature of proposed research work. The report on the research work, performed under the supervision of a faculty member, must be published in appropriate form and presented to a committee of three faculty members appointed at the time of acceptance of the thesis proposal. The student is required to give an oral defense of the thesis before the committee and other faculty members. The committee may recommend to the Graduate Affairs Committee that more than six credit-hours be granted for work of an exceptional nature. (0,12)6

16.753 Doctoral Dissertation Research**16.756 Doctoral Dissertation Research****16.759 Doctoral Dissertation Research**

Prerequisites: Written approval by the dissertation advisor; matriculated status in the doctoral program in E.E. No more than nine credits of doctoral dissertation research may be taken before passing the doctoral qualifying examination.

No more than 15 credits of doctoral dissertation research may be taken before passing the defense of the thesis proposal examination.

**Electrical Engineering
Industrial Advisory Council**

Dr. Ray Waterman, Missile Systems Laboratory, Raytheon Corp.

Ms. Cleo Alexander, Missile Systems Laboratory, Raytheon Corp.

Mr. Christopher E. Root, Dir. of Ret. Dist. Serv., New England Electric

Mr. Len Ciriello, Quality Manager, 3M Electrical Specialties

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Dr. Peter Ledger, M/A COM Semiconductor Division

Mr. William K. Vickery, Director, Ionospheric Eff. Div., Phillips Lab.

**Department of
Mechanical
Engineering**

Struan R. Robertson, Chairperson

Professors: Majid Charmchi, William Kyros, Alan Mironer, Eugene E. Niemi, Jr., John C. O'Callahan, Robert Parkin

Associate Professors: Julie Chen, John Duffy, John McKelliget,

James A. Sherwood, Sammy G. Shina, Yakov Zilberberg

Assistant Professors: Ann Mescher, Babak Minaie, David R. Smith

**Mechanical Engineering
Program**

There are three primary components to the mechanical engineering program. The first is comprised of the mathematical, physical, and engineering sciences. These form the bedrock upon which the program is built and, which provide the necessary basis for lifelong learning and adaptation in a changing technologically based society. The second is comprised of the application of these principals and modern computer aided design tools to the design, testing, and manufacture of products, systems, devices, etc. These change continually not only because of advances in software and hardware, but because of the changing emphasis of the marketplace. For example, there is more emphasis on manufacturing and commercialization and less emphasis on defense than there was only a few years ago. The third component is comprised of the humanities and social sciences that are so necessary for students to continue their growth as citizens and as professionals in a global economy. These subjects enhance the student's ability to communicate with and understand a diversity of individuals both on and off the job.

Mechanical Engineering offers a broad spectrum of career choices. Mechanical engineers can be found in every sector of our technologically complex society. There are jobs in manufacturing, power generation, material processing, ship building, aircraft, automotive, and construction companies; as well as with government organizations and consulting firms, to name a few. Opportunities are available in the design of machinery, prod-

uct design, plant design, system integration, testing, analysis, research and development. In addition to these traditional activities, mechanical engineers are deeply involved in problems of the future such as the development of new power systems, advanced composite materials, and new methods of productivity and quality enhancement in manufacturing. In view of this broadness, mechanical engineers as the general practitioners of the engineering profession have the flexibility to move into a wide variety of fields. The mechanical engineering program is structured to offer this flexibility.

The curriculum is designed to graduate engineers who can apply fundamental principles of Mechanical Engineering with competence and sensitivity to meeting the needs of society and to continue a lifelong process of learning and growth in the profession. To achieve these goals, the program begins with a heavy concentration in mathematics, physics and chemistry. These courses form the foundation upon which the engineering curriculum is built. In addition the student is introduced to computational tools and to basic engineering practice. Subsequently, there is an emphasis on engineering science and design courses where the principles of mathematics, physics, and chemistry are applied and expanded upon in the context of engineering analysis, design, and practice. Students are exposed to experimental methods for testing and evaluation of materials, thermal/fluid processes, and equipment. The senior year offers an introduction to the multiplicity of technical areas with which mechanical engineers are concerned. Through technical electives and the capstone design experience the student can explore various specialties according to their interest.

A unique feature of the program is the dispersion throughout the curriculum of the design-build-test process. Relatively simple team projects are executed in the freshman year. The complexity of the designs, the use of analytical tools, the fabrication methods, and testing techniques required, increase with each subsequent year. Students learn, hands-on, about different manufacturing techniques, about design methodologies, testing techniques, teamwork, and how to communicate their designs and work. Additionally they learn the importance and the place of applying the principals of the engineering sciences in accomplishing successful designs.

Students take a number of courses in the

humanities and social sciences. A considerable choice of subjects is allowed. These subjects broaden the student's outlook and serve to focus attention on the importance of nontechnical knowledge in being successful professionally and as a person.

The program is accredited by the Accreditation Board for Engineering and Technology (ABET), which sets the standards for all engineering programs in the U. S. A.

Five Year BS/MS in Mechanical Engineering Program

The BS/MS program makes it possible for qualified students to attain both degrees in five years. The first three years of course work is the same as that required for students in the four year BS program. Two of the technical electives taken in the senior year are double counted, provided the grade is B or better. This reduces the number of credits for the MS degree by 6. In addition, students accepted into the program do not have to take the Graduate Record Exam (GRE). Students with a GPA of 3.00 or better may enroll in this program at the end of their junior year. At the end of the senior year the BS degree is conferred. With a further year of full time study the MS degree can be completed. Students may choose to take longer to complete the program.

Course of Study for Mechanical Engineering *

General Requirements

Freshman Year

Fall Semester

25.107	Intro to Engineering I	2
42.101	College Writing I	3
	HS Elective	3
92.131	Calculus I	4
95.141	Physics I (mechanics)	3
96.141	Physics I Lab	1
		16

Spring Semester

25.108	Intro to Engineering II	2
42.102	College Writing II	3
22.211	Statics	3
92.132	Calculus II	4
95.245	Physics III (matter)	3
96.245	Physics III Lab	1
		16

Sophomore Year

Fall Semester

22.201	Mech Des Lab I CAD	2
22.212	Mech of Mat'ls	3
22.295	Materials Eng	3
92.231	Calculus III	4
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
		16

Spring Semester

22.202	Mech Des Lab II	2
22.213	Dynamics	3
22.242	Thermodynamics	3
16.211	Electrical Eng	4
92.234	Differential Eqs	3
	HS Elective	3
		18

Junior Year

Fall Semester

22.321	Design of Machines I	3
22.341	Cond & Rad Heat Tr	3
22.361	Appl Anal Meths/ME's	3
22.381	Fluid Mechanics	3
	HS Elective	3
		15

Spring Semester

22.302	ME Lab I (Instrum)	3
22.311	Appl Str of Mat'ls	3
22.322	Design of Machines II	3
22.342	Convective Processes	3
49.201/202	Economics I (II)	3
		15

Senior Year

Fall Semester

22.354	Dynamic Systems	3
22.403	ME Lab II: Appl	3
22.425	Des of Machine Elem	3
22.423	Capstone Design I	2
22.441	Anal of Ther/Fl Proc	3
22.—	ME Technical Elective	3
		17

Spring Semester

22.424	Capstone Design II	4
22.—	ME Technical Elective	3
22.—	ME Technical Elective	3
	HS Elective	3
	HS Elective	3
		16

Total Credits: 129

COLLEGE OF ENGINEERING*Department of Mechanical Engineering*

*Note that the curriculum evolves in time and that this represents the program at the time the catalog went to press.

Mechanical Engineering Courses (Prefix: 22)**22.201 Mechanical Design Laboratory I**

Course emphasis is on introducing the use of computer aided design tools in the engineering problem solving process. Assigned design projects require the use of both wire frame and solid modeling tools. Lecture and lab activities are used to support project requirements, and to provide more in-depth understanding of computer aided engineering design and drawing. Prerequisite: 25.106. (2)

22.202 Mechanical Design Laboratory II

This is an introductory course in manufacturing processes covering the basic machine tool practices utilized in the manufacturing of a product. The objective of the course is to develop broad understandings of manufacturing operations and their relationship to engineering product design. Students take the design drawings from 22.201 and fabricate the mechanical assembly using lathes, milling machines, drill presses and other conventional processes. They are introduced to metrology to determine the accuracy of the parts. Prerequisite: 22.201. (2)

22.211 Statics

The application of Newton's Laws to engineering problems in statics. The free-body diagram method is emphasized. Topics include vector algebra, force, moment of force, couples, static equilibrium of rigid bodies, trusses, friction, properties of areas, shear and moment diagrams, flexible cables, screws, bearings, and belts. Prerequisites: 92.131, 95.141. (3)

22.212 Mechanics of Materials I

Topics covered include stress and deformation analysis of bodies subjected to axial, torsional, flexural and combined loading. Buckling, and unsymmetric beam sections are studied. Prerequisites: 22.211, 92.132. (3)

22.213 Dynamics

Vector development of kinematics of a particle with respect to rotating and non-rotating frames of reference in one, two, and three dimensions. The dynamics of a

particle, system of particles, and rigid bodies. Angular momentum and the inertial properties of rigid bodies. Energy, impulse and momentum. Prerequisites: 22.211, 92.132. (3)

22.242 Thermodynamics

A detailed development of the first and second laws as applied to open and closed systems in steady flow. Concepts of work, heat, and energy. Thermodynamic properties of pure substances, condensable vapors, and the perfect gas. The concept of entropy, reversibility and irreversibility. Power cycles. Vapor and air standard cycles. Prerequisites: 92.132, 95.245. (3)

22.295 Materials Engineering

The behavior of engineering materials are studied to develop an understanding of why materials behave as they do. Emphasis is placed on the mechanical behavior and the effects of atomic structure and processing on the mechanical properties of metals, ceramics, polymers and composites. Topics of study include atomic, crystalline and non crystalline structure; thermodynamics of phase relationships and micro structural change; elasticity; plasticity, viscoelasticity, fracture mechanics and corrosion. Open ended materials selection problems are assigned. Prerequisites: 95.245. (3)

22.302 Mechanical Engineering Laboratory I: Instrumentation

Students set-up and conduct specific experiments designed to study: 1) fundamental ME instrumentation systems; 2) fundamental experimental techniques; 3) basic physical principles of mechanical systems; and 4) the application of statistical methods. Experiments are divided into two areas; solid-mechanical and thermofluids. Students develop models for use in validating and comparing with experimental results. Written communication techniques are emphasized. Prerequisites: 16.211, 22.212, 22.381. (3)

22.311 Applied Strength of Materials

The principles of strength of materials are applied to the analysis of stress in machines. The effects of combined bending, torsion, and axial loading are studied together with the effects of stress risers due to geometrical complexities. Topics include: 3-D stress transformations, principal stresses, Mohr's circles, Coulomb-Mohr and Von Mises failure criteria, and stress concentration factors. Failure under

steady and fluctuating loading is studied both deterministically and statistically. Concepts from fracture mechanics are introduced. Prerequisites: 22.212. (3)

22.321 Design of Machines I

This course concentrates on the design and kinematic analysis of linkages. The major project is a team effort, which involves the design; creation of shop-quality drawings; simulation; position, velocity and acceleration analyses; manufacture and testing of a three-position double-dwell linkage. Commercial CAD and simulation software are used. Corequisite: 22.201, Prerequisite: 22.213. (3)

22.322 Design of Machines II

This course is a continuation of 22.321 and concentrates on cam design, gear design, and power train design. The major term project involves the design, analysis, manufacture, and dynamic testing of a cam having specified characteristics. The lab uses a computer aided design tools (CAD) and computer aided manufacturing tools (CAM) to generate tool paths. Numerically controlled milling machines, and dynamic simulation codes are applied. The lab provides an opportunity for students to work together on their term project. Corequisite: 22.202, Prerequisites: 22.295, 22.321. (3)

22.341 Conduction and Radiation Heat Transfer

The theory steady and transient heat conduction in solids is developed and applied. The principals of thermal radiation with application to heat exchange between black and non-black body surfaces, and the use of radiation networks are studied. Biot and Fourier numbers are introduced. Design projects that utilize heat transfer codes are integrated into the course. Prerequisites: 22.242, 92.234. (3)

22.342 Convective Processes

Internal and external flows, Reynold's number, laminar and turbulent flows are studied. Mathematical development of the hydrodynamic boundary layer, boundary layer separation and fluid dynamic drag are covered. Forced and free convective heat transfer, the thermal boundary layer, Reynolds's analogy, Prandtl and Grashof numbers are studied. Empirical engineering convection relations are developed. The design of heat exchangers is covered. Students engage in design projects throughout the term. Prerequisites: 22.341, 22.381. (3)

22.354 Dynamic Systems

Dynamic modeling of lumped parameter mechanical, hydraulic and thermal and electrical systems. Application of ordinary differential equations, Laplace transforms, and numerical simulation to the response of systems to forcing functions and initial conditions. Energy storage, power dissipation, and work are used to obtain equivalent systems. Nonlinear systems are linearized for small perturbations about a system operating point. Prerequisites: 22.213, 92.234, 16.211. (3)

22.361 Mathematical Methods for Mechanical Engineers

Mathematical methods applied in engineering science context. Vector differential operators. Vector integration theorems. Derivation of partial differential equations of engineering science. The method of separation of variables, eigen-functions, eigen-values. Fourier series and integrals. Prerequisites: 92.231, 92.234. (3)

22.381 Fluid Mechanics

Development of basic fluid mechanical relations: continuity, momentum and Bernoulli equations. Emphasis is placed on the control volume approach to problem solving. Design projects are integrated into the course. Prerequisites: 22.212, 22.242, 92.231, 92.234. (3)

22.403 Mechanical Engineering Laboratory II: Measurement Engineering.

Continuation of Mechanical Engineering Lab I. Focuses on digital data acquisition systems used on mechanical engineering equipment. Students design measurement systems composed of various transducers, their associated signal conditioners and digital data acquisition and recording devices. Statistical methods are emphasized. Experiments require the students to provide calibration and to select appropriate sampling rates and test durations. Systems under test range from simple multisensor laboratory apparatus to actual operating mechanical systems. Prerequisites: 22.302, 22.311, 22.342. (3)

22.412 Experimental Stress Analysis

Stress and strain transformation; compatibility; introduction to theory of elasticity and stress functions. Methods for experimentally determining stress and/or strain distributions are explored. These include the electric resistance strain gage, photoelasticity, Moiré methods, photoelastic and brittle coatings, and analogies. Prerequisite: 22.311 (3)

22.423/4 Capstone Design I & II

The objective of this two-course sequence is to expose the student to basics of engineering-design practices and procedures in the field of mechanical engineering. Students perform independent design work and participate in team efforts to develop conceptual designs from functional requirements. Perform design analysis and synthesis, modeling, fabrication, testing, cost estimating, and documenting the essential elements of the system design. Prerequisites: 22.311, 22.322, 22.342, 22.354. (2), (4)

22.425 Design of Machine Elements

The principles of mechanics and commonly used failure theories are applied to the design and analysis of machine elements subjected to various load conditions. Elements studied include power screws, bolts, springs, bearings, gears, lubrication, shafts, brakes, clutches, and belts. Prerequisite: 22.202, 22.295, 22.311. (3)

22.441 Analysis of Thermo-Fluid Processes

Dimensional analysis; similitude and modeling. Mixtures of ideal gases; air-water vapor mixtures with application to air conditioning. Thermodynamic analysis of power and refrigeration cycles. Flow of a compressible fluid through a variable area passage; Mach number, choking, normal shock. Prerequisite: 22.242, 22.381. (3)

22.443 Cooling of Electronic Components

The methods of conduction, convection, boiling, and radiation heat transfer are applied to the cooling of electronic components. Analysis of complex heat sink arrays. Approximate methods and thermal circuit analogues are emphasized. Dimensionless heat transfer moduli. Matching of fan performance to air flow requirements. Heat pipes and cold plates. Prerequisite: 22.342. (3)

22.449 Design of HVAC Systems

Fundamentals of HVAC design: Evaluation of design conditions; heating and cooling loads calculations; psychometric analysis; equipment selection (cooling/dehumidifying coils, fans, refrigeration systems). Complete design of an air conditioning system for a typical single family residence in New England. Development of required specifications, drawings, and cost estimates. Prerequisite: 22.242. (3)

22.453 Mechatronics

Devices and methods to monitor and control mechanical systems, with particular emphasis on the use of embedded microprocessors. Prerequisite: 22.361. (3)

22.454 Control System Engineering

Develop ability to model, analyze, and design integrated, multi-disciplinary feedback control systems. Use of root locus and frequency response compensation techniques, along with computer aided engineering tools, to meet steady state and dynamic specifications. Modeling and design of a robot arm control system is completed and evaluated on an actual robot system. Prerequisite: 22.354. (3)

22.457 Vibrations

Fundamentals of vibration analysis of 1, 2 and multi DOF mechanical systems including the effects of damping; free response, forced response to transient and steady state harmonic and periodic excitations; the significance of natural modes, resonance frequency, mode shape, and orthogonality; vibration control, vibration isolators and absorbers; introduction to vibration measurement. Computer problems include the design of vibration control devices. A measurement project involves the use of an accelerometer, signal conditioning and analysis instrumentation. Prerequisites: 92.234. (3)

22.472 Manufacturing Processes and Systems

The objective of this course is to familiarize and engage students in the operation and control of world class manufacturing of modern plants, including the issues of Master Scheduling, Materials Requirements Planning, Process Cost Models, Just in Time Material and Production Scheduling, Production yield estimation, and product/process quality and reliability systems. In addition, topics for control of the information and performance of manufacturing systems will be presented including operations research methods, computer simulation and modeling, computer integrated manufacturing methodologies such as CAD/CAM/NC, process control and programmable logic control, manufacturing automation and information networking. Prerequisite: 22.202.

COLLEGE OF ENGINEERING*Department of Mechanical Engineering***22.473 Design for Manufactureability**

Concepts of world class design and manufacturing of modern products, including the issues of Design for Quality (DFQ), cost and the customer will be studied. Tools and techniques to be studied include Total Quality Management (TQM), statistical process control, process capability studies, six sigma quality, design efficiency ratings, design for cost, design of experiments, Analysis of Variance (ANOVA) of the mean and signal-to-noise ratio, and quality function deployment. Industrial case studies are used and student project work is required. Prerequisites: 22.202, 22.302, 22.322. (3)

22.479 Robotics

A design oriented introduction to robotics. Topics to include kinematics, inverse kinematics, static force analysis, dynamics of motion, trajectory control, optical control, vision. A student project is required. Prerequisite: 22.361. (3)

22.481 Fluid Mechanics II

Laminar and viscous flows, hydrodynamic lubrication, Navier-Stokes equations. Introduction to turbulence, Reynolds's stresses, eddy viscosity, Prandtl's mixing-length theory. Open-channel flow, hydraulic jump, uniform and non-uniform flow. Prerequisite: 22.342, 22.381. (3)

22.483 Aerodynamics

Fundamentals of subsonic aerodynamics. Atmosphere models. Air speed measurement, boundary layers, aerodynamic heating. Circulation, downwash, and three-dimensional wing theory. Airfoil data, and lift and drag of aircraft components. Power required and power available. Introduction to aircraft performance calculations. Prerequisite: 22.342. (3)

22.484 Jet Propulsion and Turbomachinery

Air breathing jet propulsion. Thrust, propulsion efficiency. Thermodynamics of Brayton cycle, component efficiencies, thermal efficiency. Comparison of turbo-prop, turbojet, and turbofan engines. Detailed performance calculation of turbofan engine using measured data and high temperature gas properties. Turbomachinery, velocity triangles, Euler's turbomachinery equation. Axial flow compressor, rotating stall and surge stability compressor map. Axial flow turbines, exhaust nozzles, afterburners. Engine component matching. Future trends in jet propulsion. Prerequisite: 22.441. (3)

22.499 Directed Studies in Mechanical Engineering

This course provides seniors in Mechanical Engineering with the opportunity to pursue the study of a technical topic or project, individually under the supervision of a faculty member and, if desired, a responsible project engineer from industry. The course is to result in a term paper or technical report. Prerequisite: permission of instructor. (3)

Graduate Courses

500 level graduate courses may be taken as technical electives, with prior approval, by seniors with at least a 3.00 GPA.

22.512 Applied Finite Element Analysis

An introduction into finite element methods using popular commercial packages. The features common to different programs as well as special features of particular programs are presented. Primary focus is on hands-on familiarity of the software with a limited discussion of the underlying finite element theory. ALGOR, ADINA, ABAQUS, LS-DYNA3D, ANSYS, HyperMesh, FEMAP, and SDRC-IDEAS are among the pre/postprocessing and analysis packages used in the survey. (3)

22.513 Finite Element Methods

Matrix algebra and the Rayleigh-Ritz technique are applied to the development of the finite element method. The minimum potential energy theorem, calculus of variations, Galerkin's and the direct-stiffness method are used. Restraint and constraint conditions are covered. C0 and C1 continuous shape functions are developed for bar, beam, and two and three dimensional solid elements. Recovery methods, convergence and modeling techniques are studied. Applications to problems in static stress analysis and heat conduction. (3)

22.515 Modal Analysis I - Theoretical

Review of single and multiple degree of freedom systems using classical and Laplace formulations. Finite element methods for dynamic systems. Model reduction/expansion formulations. Modal participation and mode activation concepts. Linear algebra review, matrix formulations, matrix eigenanalysis, generalized inverses, spectral and singular valued decomposition techniques. Fourier transformations. Models developed using MAT_SAP and MATLAB. (3)

22.527 Solar systems Engineering

Systems engineering, stochastic modeling, design, and life-cycle cost analysis of several solar systems: photovoltaics, passive heating, solar cooling, and daylighting. (3)

22.531 Advanced Mathematics for Mechanical Engineers

Analytical and numerical solution of ordinary and partial differential equations that are applicable to mechanical engineering. Included in the topics covered are; review of solution techniques for linear O.D.E.'s with constant coefficients, trajectories, Picard iteration, Newton-Raphson, Gauss-Seidel, Runge-Kutta, systems of O.D.E.s, Legendre and Bessel functions, generalized Fourier series, boundary and initial value problems, separation of variables, and finite difference techniques. Membrane, wave propagation, and heat conduction problems are analyzed. (3)

22.534 Applied Numerical Methods

Number systems and error. Gaussian methods of linear algebra. Matrix eigenvalues. Difference and summation calculus. Interpolation. Definite integrals. Differential equation modeling and stability. Orthogonal polynomials. Roots of polynomials. Zeroes of single variable functions. Optimization. (3)

22.543 Convective Heat and Mass Transfer

Conservation equations. Heat transfer in laminar and turbulent boundary layer and duct flow. Free convection. Convective mass transfer. (3)

22.544 Conductive and Radiative Heat Transfer

Steady and unsteady state heat conduction: analytical solutions. Radiative heat transfer between surfaces and participating media. (3)

22.547 Numerical Methods in Thermo-Fluid Systems

Fundamentals of finite difference schemes: stability, consistency and accuracy. Application of state-of-the-art numerical methods to the solution of problems involving fluid flow, heat transfer, chemical reactions and turbulence. (3)

22.550 Advanced Vibrations

Modeling and solution of multi-degree of freedom problems. Matrix methods are used along with an applications program. Shock spectrum methods and non-linear effects are considered. (3)

22.551 Advanced Dynamics

Formulation of advanced representations of kinematics and dynamics. Development of Lagrangian and Hamiltonian dynamic equations. Dynamics of systems with constrained motion. Principal of virtual work. Gyroscopic effects. Introduction to non-holonomic systems. (3)

22.554 Dynamic Systems and Control

Matrix-based classical and modern techniques are applied to the dynamics of control systems. Design of controllers, and full and reduced-order observers. Introduction to optimal control and Kalman filters. (3)

22.562 Solid Mechanics

Topics covered include the theory of stress, kinematics of strain, Hooke's Law, work and energy, equations of stress equilibrium, Navier's equations, strain compatibility, and the Beltrami-Michell equations. Problems for uniformly varying 3-D states of stress, torsion, plane and axisymmetric deformation are studied. . Prerequisite: 22.531. (3)

22.571 Concurrent Engineering and Quality

Focuses on methodologies used by world class companies to guide the design and development of high quality, low cost products in the most timely manner through the use of analytical tools in case studies. Topics include: new product creation strategy and process, organizational aspects of multi-disciplinary design teams, concurrent project management, and structural methodologies for identifying customer requirements and manufacturing process design, control and selection. In particular, focus is on the interrelationship of CE, manufacturing and Quality tools and methodologies and how they contribute in determining the appropriate level of product/process quality and design efficiency. (3)

22.572 Manufacturing Processes

Ferrous and non-ferrous, plastic and ceramic material behavior and properties. Electronic manufacturing processes, including printed board fabrication, population and soldering. Casting, materials forming and shaping. Surface preparations and heat treatment. Joining processes, welding design and selection. (3)

22.573 Manufacturing Systems

The design and evaluation of manufacturing systems: stochastic process models, discrete and continuous Markov chains, queueing theory, optimization, and linear and integer programming. (3)

22.575 Industrial Design of Experiments

Concepts of Robust Design and statistical Design Of Experiments (DOE) as applied to the design and manufacturing of new high technology products. Classical and current methodologies of DOE including Full Factorial, Fractional Factorial, Taguchi, Central Composite and Yates Algorithms. The course will also provide for different methods for experimental design and analysis, including average and variability analysis. Commercial software packages and case studies using industrial experiments will be used to illustrate the material. (3)

22.577 Event Driven Manufacturing

This course develops and applies the tools to analyze, predict and control production flow under diverse product manufacturing conditions. Topics covered include, group technology, the Li/Parkin sorting algorithm, multi-dimensional category sorting, time-driven simulation systems, event-driven simulation, product assembly templates, production simulation and scheduling, bottleneck identification, and hierarchical system interrogation.

22.579 Robotics

Common robotics joints and robotics classification. Planes of motion and fold lines. Robotics capability. Forward and inverse kinematics and the RobSim software package. Trajectory planning and elementary obstacle avoidance. Robotics dynamics and feasible trajectory evaluation. Design of the control system for the non-linear robotics problem. Classroom studies are followed by hands-on applications in the Automated Manufacturing Assembly and Robotics Laboratory. (3)

22.581 Advanced Fluid Mechanics

Fundamental equations of fluid motion, kinematics, vorticity, circulation, Crocco's theorem, Kelvin's theorem, Helmholtz's velocity laws, secondary flows. Stream function, velocity potential, potential flows. Unsteady Bernoulli equation, gravity water waves. (3)

22.582 Viscous Flow

Derivation of Navier-Stokes equations. Examples of exact solutions. Laminar and turbulent boundary layer. Low Reynolds number flow. (3)

22.589 Finite Element Method in Thermal/Fluids

Galerkin techniques are used to derive the finite element equations for viscous and nonviscous flows, and heat conduction. Isoparametric elements are studied. Application to laminar and low speed turbulent flows and to problems in heat conduction are made. (3)

22.591 Mechanical Behavior of Materials

Quantification of structure-property relationships requires application of solid mechanics concepts to materials microstructure. Using micro-mechanics approach, the course focuses on the deformation and fracture behavior of metals, ceramics, composites and polymers. Topics include: elastic behavior, dislocations, crystal plasticity, strengthening mechanisms, composite materials, glassy materials, creep and creep fracture, tensile fracture, and fatigue. (3)

22.593 Failure Analysis

The prediction, analysis, and prevention of failure in mechanical design is covered. Failure mechanisms such as creep, plastic deformation, crack propagation, cyclic fatigue, thermal fatigue, fretting and galling are considered. Theories of failure such as Colomb-Mohr, Beltrami, and Huber-Von Mises are used to predict failure. Cumulative damage theories such as those of Gatts, Corten and Dolan, Marin, and Manson will be studied. Statistical methods of analysis and test data interpretation are studied. Materials such as steels, aluminum alloys, solders, plastics, and composites will be considered. (3)

22.596 Composite Materials

Analysis of anisotropic lamina and laminated composites. Methods of fabrication and testing of composites. Other topics include environmental effects, joining and machining. (3)

COLLEGE OF ENGINEERING

Plastics Engineering Program

Plastics Engineering Program

Robert E. Nunn, Chairperson

Stephen Orroth, Executive Officer

Professors: Aldo Crugnola, Drudolph Deanin, Stephen Driscoll, Steven Grossman, Jan-Chan Huang, Francis Lai, Robert Malloy, Stephen McCarthy, Robert Nunn, Stephen Orroth, Stephen Petrie, Nick Schott, Amad Tayebi

Associate Professor: Ross Stacer

Assistant Professor: Carol Barry

This program is designed to prepare the graduate for a professional career in the polymer industries of which plastics is the largest. Other segments include man-made fibers, rubber, coatings, and adhesives. The curriculum provides a sound basis in mathematics, chemistry and process engineering, plus a full study of plastics materials, properties, physics, engineering sciences, and product design. It includes sufficient flexibility for further specialization in areas of individual interest. Undergraduates may join the nation's first student chapter of the Society of Plastics Engineers (SPE). Other Engineering societies that are relevant are SAMPE and SAE.

Since the program started in 1954, more than 2000 graduates have been employed by polymer industries throughout the United States, Europe, and Asia. Major plastics producers and users recruit annually on campus. While most job openings are in manufacturing, product and process development, or in technical service and marketing, some graduates go into research, consulting, and teaching. The program is accredited by the Accreditation Board for Engineering and Technology (ABET).

Course of Study for Plastics Engineering

Freshman Year

Fall Semester

25.107	Intro to Engineering I	2
42.101	College Writing I	3
84.121	Chemistry I*	3
84.123	Chemistry Lab I	1
92.131	Calculus I*	4
95.141	Physics I*	3
96.141	Fund Exp Physics I	1

17

Spring Semester

25.108	Intro to Engineering II	2
42.102	College Writing II	3
84.122	Chemistry II*	3
84.124	Chemistry Lab II	1
92.132	Calculus II*	4
95.144	Physics II	3
96.144	Fund Exp Physics II	1

17

*Appropriate honors courses may be substituted by qualified students.

Sophomore Year

Fall Semester

22.211	Engg Mechanics	3
26.001	Pl Safety Lecture	0
26.201	Poly Materials I	3
26.215	Pl Proc Lab I	1
84.203	Applied Org Chem	3
84.205	App. Org Chem Lab	1
92.231	Calculus III	4

15

Spring Semester

26.002	Pl Safety Lecture	0
26.202	Poly Materials II	3
26.212	Part/Body Dynamics	1
26.216	Plastics Proc Lab II	1
26.218	Intro to Pl Design	2
26.247	Thermodynamics	3
92.234	Differential Equations	3
	Aesthetics	3

16

Junior Year

Fall Semester

26.001	Pl Safety Lecture	0
26.301	Poly Materials III	3
26.314	Fluid Flow	3
26.315	Pl Process Lab III	1
26.377	Pl Proc Eng I	3
49.201	Economics	3
	Historical Studies	3

16

Spring Semester

26.002	Pl Safety Lecture	0
26.306	Exp. Analysis	3
26.316	Pl Proc Lab IV	1
26.348	Heat Transfer	3
26.373	Pl. Mold Eng.	3
26.378	Pl Proc Eng II	3
84.339	Phys Chem Prin	2
84.341	Phys Chem Lab	1

16

Senior Year

Fall Semester

26.001	Pl Safety Lecture	0
26.403	Phy Prop Poly	3
26.404	Process Control	3
26.415	Phys Prop Lab I	1
84.403	Int Poly Sci I	3
84.405	Polymer Lab I	1
	BS,BA,BSV Elective	3
	Tech Elective**	3

17

Spring Semester

26.002	Pl Safety Lecture	0
26.406	Polymer Structures	3
26.416	Phys Prop Lab II	1
26.418	Prod. Proc. Design	3
	Literature Elective	3
	Values Elective	3
	Technical Elective**	3

16

Total credits: 130

**Students registered for Co-op program may, with the prior approval of the Department's Co-op Advisor, take 25.491/2/3 (Industrial Experience) to satisfy the Technical Elective requirements.

Combined B.S. /M.S. Engineering

Degree Program In Plastics

The Plastics Engineering Department offers a program of accelerated study in order to encourage outstanding (GPA 3.0) undergraduate students to continue their studies toward an advanced degree in plastics and other polymer applications. Interested students should file a Graduate School application in the junior year. Applicants for this program are not required to take the Graduate Record Examination.

Upon recommendation of the student's advisor, and with the approval of the department graduate admissions committee and the Dean of the Graduate School, the student may be admitted to graduate study during the second semester of the senior year as a provisional graduate student.

The student will receive a Bachelor's degree at the end of the fourth year of study, if all course requirements have been met. Acceptance as a matriculated gradu-

ate student is contingent upon the further recommendation of the department committee and the approval of the Dean of the Graduate School. Up to eight credits of the B.S. degree may be applied to the Graduate Program.

Fall Semester

A graduate course in Plastics Engineering may be taken in place of an undesignated elective (three credits). Students may take a graduate seminar (one credit).

Spring Semester

A graduate course in Plastics Engineering may be taken in place of an undesignated elective (three credits). Students may take a graduate seminar (one credit).

In some cases, an undergraduate student may take additional graduate courses, credits for which are not applied to the minimum University requirements for the Bachelor of Science in Engineering, and apply these to the Master of Science in Engineering. However, no student may transfer more than 12 credits into the Graduate Program.

During the summer preceding the fifth year, the student, if accepted as a matriculated student in the Graduate School, will begin his or her thesis research. By the end of the fifth year the student may expect to have completed 16 credits of graduate electives and six credits of thesis research, in addition to the credits taken in the senior year which are applicable to the master's degree program.

Students taking full advantage of the combined program ordinarily may expect to finish the M.S. Engineering degree at the end of the fifth year of study. Actual completion will depend upon the student's course load and thesis work.

A student may be eligible for financial assistance, i.e., fellowships and teaching assistantships, during the fifth year of study, but acceptance of such assistance and the attendant responsibilities may delay the completion of the program beyond the period specified in the preceding paragraph.

Plastics Engineering (Course Prefix: 26)

26.201 Polymeric Materials I

An introductory course reviewing the history, classification, definitions and terminology, raw materials, methods of manufacturing, testing-characterization of typical physical properties, and end-uses of polymeric materials systems. The lectures will focus on an in-depth review of the major families of thermosetting resins: phenolics, aminos, polyesters, epoxies, silicones, and various polyurethane systems. Emphasis is on basic chemistry, inherent physical properties and processability, and the effect of incorporating fillers, reinforcements, colorants, lubricants, and other chemical additives in order to engineer-in necessary processing ease and to meet functional performance, and end-use demands. Prerequisite: 84.122. (3,0)3

26.202 Polymeric Materials II

Continuation of 26.201 with emphasis on the three major addition-type thermoplastics: olefins, vinyls, and styrenics. Comparisons of properties, processability, and end-use performance. Alloys and blends of these base resins will also be considered. Prerequisite: 84.122. (3,0)3

26.212 Particle and Body Dynamics

Dynamics of particles and rigid bodies, energy impulse and momentum. Angular momentum and inertial properties of rigid bodies. (1,0)1

26.215 Plastics Process Engineering Laboratory

A laboratory course to study polymer processing methods. Experiments are designed so that the student will understand the theory of polymer conversion techniques by the interaction between process variables and materials. Some of the conversion methods studied are extrusion, injection molding, blow molding, thermoforming, compounding and mixing. Corequisite: 26.201. (0,3)1

26.216 Plastics Process Engineering Laboratory II

Continuation of 26.215. Corequisite: 26.202. (0,3)1

26.218 Introduction to Plastics Design

Introductory course developing the fundamentals of design principles in plastics applications. Commercial design software will be used. (1,2)2

26.247 Elements of Thermodynamics

The principles of thermodynamics, a study of the first and second laws of thermodynamics with applications to classic power generation and refrigeration systems and polymer systems. Thermodynamic properties of polymers. The concepts of entropy, reversibility, irreversibility and availability. Prerequisite: 92.231. (3,0)3

26.301 Polymeric Materials III

A continuation of 26.201, 26.202 with emphasis on engineering and specialty high performance polymers, etc. Prerequisite: 26.202. (3,0)3

26.306 Methods of Experimental Analysis

Basic concepts dealing with the interpretation of experimental engineering results. Deterministic vs. stochastic processes. Elementary probability theory and common distributions. Graphical analysis and mathematical modeling. Statistical parameters and their applications to quality control, and tests of significance. Design of experiments (DOE) for process development and optimization.

26.314 Fluid Flow and Rheology of Polymers

Statics and dynamics of Newtonian and Non-Newtonian fluids. Flow in closed conduits, measurement of fluid flow, flow of suspensions, rheology of melts, viscous dissipation, temperature and entrance effects. Applications of flow equations to plastics processes. Prerequisite: 92.231. (3,0)3

26.315 Plastics Process Engineering Laboratory III

Laboratory instruction of a more advanced nature in the processing and fabrication of plastics materials. A continuation of the processing laboratory sequence but with the emphasis on student designed experiments. Prerequisites: 26.216, 26.202. (0,3)1

26.316 Plastics Process Engineering Laboratory IV

Continuation of 26.315. Prerequisites: 26.216, 26.202. (0,3)1

26.348 Heat Transfer

Theory and application of steady and transient heat conduction, convection, and radiation. Heat transfer in plastics processing. Heat transfer and polymeric viscous dissipation in fluids. Prerequisites: 92.231, 92.234. (3,0)3

COLLEGE OF ENGINEERING*Plastics Engineering Program***26.373 Plastics Mold Engineering I**

Course work entails the introduction to the fundamentals of plastics mold and die engineering with the objective to develop an overall appreciation of the mold engineer's job. Emphasis is placed on an integrated approach to mold engineering which includes the interrelationships of polymeric materials, engineering principles, processing, and plastics product design: mold and die design/construction, and design communications. Laboratory consists of the actual design of a mold or mold components with emphasis on CAD and computerized Material Databases. A semester project is required. Junior status or permission of instructor. (2,2)3

26.377 Plastics Process Engineering I

A study of the fundamental principles of polymer processing, i.e., the conversion of the polymeric materials into useful articles. Correlation between process variables, material characteristics and parts design are studied to determine the functional relationships between them.

Prerequisites: 26.215, 26.216.

Corequisite: 26.315. (3,0)3

26.378 Plastics Process Engineering II

A continuation of 26.377. Prerequisite: 26.377. (3,0)3

26.403 Physical Properties of Polymers

Introduction to basic mechanical properties of polymers as linear viscoelastic materials. Concepts of creep, stress relaxation, and superposition principles are emphasized. Dynamic mechanical behavior, interrelations between various properties, electrical behavior, miscellaneous mechanical properties, optical properties.

Prerequisite: senior status. (3,0)3

26.404 Process Control Systems

Basic principles of control systems used with plastics processing equipment. Included are instrumentation, signal conditioning, data acquisition, feedback control, process monitoring, data reduction, SPC/SQC, and Taguchi methods.

Prerequisite: 92.234 or permission of instructor. (3,0)3

26.406 Polymer Structure, Properties, and Application

The fundamental relationships between molecular structure, properties and end-use applications of plastics materials will be explored in detail. Molecular structural

features include chemical composition, molecular size and flexibility, intermolecular order and bonding, and supermolecular structure. Properties include processability, mechanical, acoustic, thermal, electrical, optical and chemical properties, price, and balance of properties. Applications include rigid solids, flexible solids, foams, film and non-plastic applications. (3,0)3

26.407 Plastics Industry Organization

Economics of producing plastics raw materials and converting them into end products, from research and development to plant construction, operation, and marketing. Market analysis of plastics production, processing, and consumer patterns; commercial development, sales, and technical service. Organization of the plastics industry for research and development, specialty and commodity production, profit and growth. Prerequisite: permission of instructor. (3,0)3

26.409 Senior Research in Plastics I

Individual research projects in plastics chemistry, properties, processing, products, and industry organization. Students will review the existing literature, obtain materials and equipment, plan and carry out research programs and submit final reports for publication. Prerequisite: permission of instructor. (0,6)3

26.410 Senior Research in Plastics II

Continuation of 26.409. (0,6)3

26.413 Senior Projects I

Assignment of senior projects designed to develop the student's ability to organize and conduct investigations on material performance and processing techniques. Prerequisite: permission of instructor. (0,3)1

26.414 Senior Projects II

Continuation of 26.413. (0,3)1

26.415 Physical Properties Laboratory I

Measurement of mechanical properties in tension, compression, shear, and flexure; dielectric constant and dissipation factor; thermal behavior under stress; melt rheology. (0,3)1

26.416 Physical Properties Laboratory II

Continuation of 26.415. (0,3)1

26.418 Product and Process Design

Theoretical principles and sound engineering practice involved in the design of new end products made from polymers, applying the total systems approach to the balance between product design, choice of materials, tool design, and process techniques, as they affect competitive choices for commercial success. A semester project is required. Prerequisite: senior status or permission of instructor. (3,0)3

Primarily for Graduate Students and students in the five year BS/MS Program.

Graduate courses are open to undergraduates with permission of the instructor. Courses marked with an asterisk (*) will be offered only if there is sufficient student demand.

26.502 New Plastics Processing Techniques

Critical examination of new plastics processing techniques appearing in the research literature and being commercialized in the plastics industry. (3,0)3

26.503 Mechanical Behavior of Polymers*

Mechanical properties of bulk polymers. Linear viscoelasticity, creep, relaxation, dynamic and stress/strain response phenomena. Principles of time/temperature superposition. Rubber elasticity. Failure behavior of polymeric materials. (3,0)3

26.504 Physical Properties of Polymers*

Polymers as linear viscoelastic materials. Creep, stress relaxation, superposition, dynamic mechanical behavior, electrical behavior, miscellaneous mechanical properties, optical properties, transport properties. (3,0)3

26.505 Polymer Structure II

Continuation of 26.504 (3,0)3

26.506 Polymer Structure, Properties, and Applications

Relationships between polymer structure (chemical composition, molecular weight and flexibility, intermolecular order and bonding, supermolecular structure) and practical properties (processability, mechanical, acoustic, thermal, electrical, optical, and chemical) and applications. (3,0)3

26.507 Plastics Industry Organization

Economics of producing plastic raw materials and converting them into end products, from research and development to plant construction, manufacturing and marketing. Market analysis of plastics production, processing, and consumer patterns; commercial development, sales, and technical service. Organization of the plastics industry for research and development, specialty and commodity production, profit, and growth. (3,0)3

26.509 Plastics Processing Theory I

Principles of rheology and continuum mechanics involved in the processing of plastics, and their applications in plastics process engineering including flows in standard geometries and extrusion applications. (3,0)3

26.510 Plastics Processing Theory II

A continuation of Theory I using the transport phenomena approach to analyze and describe plastics conversion processes, including roll processing blown film extrusion, injection molding, and mixing. (3,0)3

26.511 Polymer Blends and Multiphase Systems*

Physical, mechanical, and thermal properties, preparation, and testing of polymer blends, alloys, and multiphase systems. Thermodynamic theories and experimental determination of miscibility of polymer blends. Structure property relationships for multiphase systems and interpenetrating networks. (3,0)3

26.512 Plastics Foams*

Preparation, structure, and properties of plastics foams. Practical systems in development and production. Properties, applications, and markets for plastics foams and products made from them. (3,0)3

26.513 New Plastics Materials*

Critical examination of the new plastics appearing in the research literature and being field-tested for commercialization in the plastics industry. (3,0)3

26.516 Composite Materials

The potential of composites as a class of materials, and the uniqueness of the mechanical/physical properties realizable. Fundamental concepts underlying those properties, with particular emphasis on fibrous reinforced plastics. Survey of matrices, reinforcements, and prediction

of composite properties from a knowledge of the properties and topology of constituent materials. Factors affecting ultimate strength and fatigue behavior. (3,0)3

26.518 Product Design

Theoretical principles and sound engineering practice involved in the design of new end products made from polymers applying the total systems approach to the balance between product design, choice of materials, and process technique, as they affect competitive choice for commercial success. A semester project is required. (3,0)3

26.523 Plastics Process Analysis

Energy balances, energy efficiency for extrusion and injection molding, application of energy equation (conduction, convection, viscous dissipation), equations of state, melt conveying in simple and compound screws, screw scale up, plastication. (3,0)3

26.524 Process Analysis, Instrumentation and Control*

Industrial instruments for measurement and control of plastics processes. Design of experiments. Analysis of plastics forming operations. Dynamic testing techniques. Automatic plastics process control. Modeling and process simulation in extrusion and injection molding. Data acquisition systems, SPC/SQC and Taguchi methods. (3,0)3

26.525 Processing of Synthetic Fibers and Structures*

An introduction to systems utilized in the processing of synthetic fiber structures. These include drawing, winding, texturing, staple fiber production, blending, spinning, weaving, knitting, braiding and production of non-wovens. The effect of these mechanical, and physical processes on the resultant fiber structure and behavior. (3,0)3

26.526 Advanced Processing of Synthetic Fibers and Structures

A continuation of 26.525 to include a more detailed view of the processes and effects involved. (3,0)3

26.527 Mechanics of Fibrous Structures*

Characteristics of fibers as affecting performance of conventional and non-conventional fibrous structures. Design

considerations and mechanical behavior of twisted, knitted, woven, braided and non-woven fibrous materials. (3,0)3

26.528 Plastics Information Seminar

Review of procedures for literature searching, data bases, etc. (1,0)1

26.529 Fiber Evaluation*

Basic mechanical tools, techniques and their utilization by industry for research, development, production control and end use evaluation. Moisture equilibrium and rates of change relations, basic fiber, yarn and structure dimensions; and an introduction to the determination and evaluation of the stress-strain-time properties of fibers and fiber structures; wear and abrasion are among the topics considered. (3,0)3

26.530 Selected Topics: Plastics I

Topics in various fields of Plastics Engineering. Content may vary from year to year so that students may, by repeated enrollment, acquire a broad knowledge of contemporary Plastics Engineering. (3,0)3

26.531 Survey of Synthetic Fibers and Fiber Structures*

General discussion of the basic problems encountered in the synthetic fiber industries, including fiber structure and properties, processing, utilization and various aspects of current research. Recent advances and projected developments. (3,0)3

26.532 Adhesives and Adhesion*

Adhesive joining of engineering materials. Surface chemistry, theories of adhesion and cohesion, joint design, surface preparation, commercial adhesives, rheology, equipment, testing, service life, and reliability. (3,0)3

26.533/534 Plastics Coatings I and II

Polymers, pigments, solvents, and additives used in coatings. Methods of polymerization, formulation, application, and testing. Substrates and applications. (3,0)3

26.535 Rubber*

Polymerization and compounding of the commercial elastomers. Properties and test methods. Leading applications and methods of processing. (3,0)3

26.536 Rheology of Coatings*

Rheology of polymer melts, solutions, latexes, and pigment dispersions, and their application to coatings and adhesives. (3,0)3

COLLEGE OF ENGINEERING

Plastics Engineering Program

26.537 Engineering Properties of Plastics*

Theoretical basis and practical significance of the mechanical, thermal, electrical, optical and chemical properties of plastic materials. Importance of engineering properties in material development and selection and in product design. (3,0)3

26.538 Selected Topics: Plastics II

Continuation of 26.530. (3,0)3

26.539 Selected Topics: Plastics III

Continuation of 26.530. (3,0)3

26.540 Commercial Development of Polymeric Material Systems*

The concepts of industrial marketing will be reviewed for research, pricing strategies, and product planning for market segmentation, place (distribution) -promotional activities. Topics will include creating a demand, selling, and servicing base resins and additives. (3,0)3

26.541 Computer Applications*

An introduction to microprocessor programming and interfacing. Programming includes logic operations, branch and jumps, and subroutines. Interfacing includes input and output, data acquisition systems, and controller design. (3,0)3

26.543/544 Survey of Plastics Materials

Descriptive course centering on the historical development of polymeric systems, their synthesis, structure, properties, and applications. Included will be a brief discussion on the typical additives employed to make plastics molding compounds. Not open to undergraduate plastics students. (3,0)3

26.545 Additives for Polymeric Material*

Additives incorporated into polymers to modify processing and end-use properties: reinforcements, plasticizers, stabilizers, flame retardants, colorants, biostats, blowing agents, anti-stats, impact modifiers, and processing aids. (3,0)3

26.546 Mixing in Plastics Processing*

Solids mixing, mixing in viscous fluids, admixing, concept and techniques of residence time distribution, continuous and batch processes, improvement of extrudate quality, scale-up and theory of similarity, dispersion and distributive mixing, mixing and heat transfer. (3,0)3

26.547 Analytical Techniques for Plastics Engineers

Vector and tensor analysis, matrices and determinants, vector differential calculus, Laplace and Fourier transforms, power series, partial differential equations, introduction to numerical analysis. Use of the above techniques in plastics engineering calculations. (3,0)3

26.548 Numerical Techniques for Plastics Engineers*

Use of numerical methods in the solution of problems concerning rheology, heat transfer, diffusion, and viscoelastic theory. Topics include solutions to ordinary differential equations, simultaneous linear equations, finite difference methods, finite element methods, plotting, linear regression, linear interpolation, curve fitting and optimization techniques. (3,0)3

26.552 Design of Polymer Processing Machinery*

Hydraulics, machine logic, drives, pumps, motors, heating barrel and screw combinations, mechanical design. Hydraulic and electrical control circuits development. A semester project is required. (3,0)3

26.555/556 Rheology and Characterization Practicum*

Practical review of theoretical concepts of rheological measurements with practical applications of experimental techniques. Emphasis will be on the viscoelastic properties of polymer solutions, melts, and solids with correlation with theoretical dynamic mechanical behavior. (3,0)3

26.557 Composites Fabrication I

Introduction to resins and reinforcements. Fabrication of thermoset composites. Hand lay-up, vacuum bagging, autoclaving, compression molding, rheological testing. Design concepts, product management, quality control. (2,3)3

26.558 Composites Fabrication II

A continuation of 26.557 with emphasis on a semester project on design, processing, and economics of composites. (2,3)3

26.559 Elements of Packaging*

Packaging methods, materials, and container designs. Analysis of container manufacturing methods for paper, plastics, cans, cardboard, and their specific properties. (3,0)3

26.563/564 Materials Seminar I and II

Individual research and presentation in the field of Plastics Materials. (1,0)1

26.565 Engineering Polymers

A Continuation of 26.543/544 with emphasis on the engineering, high performance, and specialty polymers, including nylons, acetals, acrylics, polycarbonates, polyaryl sulfones, LCP's, polyimides, fluoropolymers, and engineering alloys/blends. Prerequisites: 26.543/544. (3,0)3

26.566 Polymeric Material Systems Selection*

This course investigates the selection processes to be followed in screening material candidates, and specifying a material of record. Emphasis is placed on prioritizing performance requirements, contrasting potential candidates, reviewing processing demands, and post-fabrication schemes. The course will be based on actual case studies. Prerequisites: 26.201/202/203 or 26.543/544/565. (3,0)3

26.567/568 Dynamic Mechanical Properties I and II

Methods of dynamic mechanical analysis of polymers and plastics. (3,0)3

26.575 Biomaterials

An appropriate understanding of biomaterials demands a broader view of the field than study limited to the properties of the different metals, ceramics, plastics, elastomers, textiles and composite structures employed as body implants. To advance a fuller appreciation of the challenges offered, the course will include: lectures devoted to the anatomy and physiology of the human body, an introduction to the biomechanics of hard and soft tissue, lectures treating the body's response through inflammation and infection to implanted materials and devices and a case study that follows the development of an IMPLANT from its conception through a) its mechanical/material design, b) its in vitro and in vivo evaluation, c) its conformance to pertinent government regulations and d) its final adoption as a clinical procedure. Prerequisites: An engineering degree that includes a course in materials or permission of the instructor.

*Plastics Engineering Program***26.579 Problems in Biomaterials - Directed Studies**

Selection of a current biomaterial problem of interest by the individual student, examination of pertinent literature to determine present knowledge in the area, formulation of an approach to resolve or clarify the issues involved, and (time permitting) work towards the solution of the selected problem. Prerequisites: 26.575 or permission of the instructor.

26.580/581 Polymer Science I & II

An introductory course in polymer science and technology including basic classification and molecular structures, synthesis, solution properties and molecular weight determination, solid-state properties including both the amorphous and crystalline states, degradation mechanisms, polymer reactions, network formation, copolymerization and blends/alloys. This class is only offered in the evenings and may be used as a substitute by Plastics Engineering majors for 97.503/504. (3,0)(3,0)6

26.582/569 Design Seminar I and II

Individual research and presentation in the field of Plastics Design.

26.583 Research Methodology*

A systematic evaluation of the techniques used in efficient research and development. Experimental data are analyzed and plotted using a mathematical approach. Creative thinking, problem solving, and student presentation of data are stressed. Extensive reading of research papers, analysis of such, and defense of the analysis required. (3,0)3

26.584/570 Processing Seminar I and II

Individual research and presentation in the field of Plastics Processing. (1,0)1

26.585/586 Computer Aided Engineering and Design*

Design of plastic components and molds. Finite element programs to perform linear and nonlinear stress analysis. Moldflow program for detailed mold design. Prerequisites: 22.421. (3,0)3

26.590 Survey of Intellectual Property (in the Plastics Industry)

A review of patents, trademarks, copyrights and their application for protection of technology in the plastics industry. Other topics to be considered will be

employee rights/non-competition agreements, foreign protection, and technology licensing. (3,0)3

Plastics Engineering Industrial Advisory Council

Mr. John C. Andries, Teknor Apex Company

Mr. Edward Augustyn, Omya Inc.

Mr. Richard E. Barry, Novacor Corp, Inc.

Mr. Karl Baur, Kistler Instrument Corp.

Mr. Thomas Bezigian, PCT Technologies

Mr. Brett Blaisdell, Eastman Kodak Company

Mr. Andrew Bobkowitz, Keller Companies, Inc.

Mr. Paul Boudreau, Husky Injection Molding Systems, Ltd.

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Mr. Fred J. Charpentier, Cincinnati Milacron Corp.

Mr. Charles Chiklis, Consultant

Ms. Teri Contino, Barry Controls

Mr. Gregory Croteau, Hoechst Celanese Engineering

Mr. Desi Csongor

Mr. Paul Dalton, Lakeshore Polytech

Mr. Paul J. DiCicco, Davol Incorporated

Mr. Joseph M. DiVerdi, Monsanto Corp.

Mr. Richard Donahue, Computervision Corp.

Ms. Paula Donato, Polaroid Corp.

Mr. Robert Egbers, Arco Chemical Co.

Mr. Kurt Eise, TUV America

Mr. F. Reed Estabrook, Jr., Consultant

Mr. Thomas Falcone, Syracuse Plastics, Inc.

Mr. Dave Ferguson, James Layton International

Mr. Don Fesko, Ford Motor Company

Mr. Angelo Firenze, Dynisco Corp.

Mr. William Flickinger, HPM Corporation

Mr. Nick Fountas, James Layton International

Mr. Milton Francis, Risden Corporation

Mr. Iver J. Freeman, Consultant to the Plastics Industry

Mr. Norm Fowler, Xerox Corporation

Mr. Lindsay Gable, Shape, Inc.

Mr. Robert Gallagher, Blue Water Plastics, Inc.

Mr. Philip Gately

Mr. Paul Georgoudis, IPM Industries

Mr. Russel J. Gould, RG Associates

Mr. Lawrence Guilbault, Morton Thiokol, Inc.

Mr. Roger Guillemette, Guill Technologies

Mr. Bernard M. Halpin, Jr., Army Materials & Mechanics Research Ctr. Mr. Mark Hamilton, Cincinnati Milacron

Mr. Bob Hange, Freudenberg, NOK

Mr. John Hudson, C.R. Bard, Inc.

Mr. Charles C. Hwo, PhD., Shell Development, Westhollow Res. Center

Mr. Steven Iannelli, Koch Membrane Systems

Mr. Steve Keaney, USCI Division of C.R. Bard, Inc.

Mr. Clarence Kenon, 3M Electrical Specialties Division

Mr. M. Barr Klaus, Cincinnati Milacron, Inc.

Ms. Denise Kniager, Dow Chemical Co.

Mr. Howard Koenig, American White Cross

Mr. John C. Kwok, Polysar, Inc.

Mr. Richard Lassor, General Electric Company

Mr. Carl Letendre, ETC Laboratories

Mr. Anthony Listro, Judd Wire & Cable

Mr. Alan Litman, Xerox Corp.

Mr. Glenn Longwell, Moldflow Inc.

Mr. Charles E. Lundy, Mobay Corporation

Mr. Abboud Mamish, Polyken Technologies

COLLEGE OF ENGINEERING*Faculty*

Mr. C. Gordon McCarty, Mobay Corp.
Mr. James McDonough, BIC Corporation
Mr. Lawrence McKenna, Advent International Corp.
Mr. Ravi Mehra, Nalge Co., Division of Sybron Corp.
Mr. Kishor S. Mehta, Mobay Corp.
Mr. Wolfgang Meyer, Battenfeld of America, Inc.
Mr. Ralph L. Mondano, 3M Company
Mr. Dale Moore, Ford Motor Company
Mr. E. Bradley Moynahan, U.Mass Amherst
Mr. Philip S. Nachman, Nachman Biomedical Corp.
Mr. Matthew H. Naitove, Plastics Technology
Mr. David J. Nunes, Alpine American Corp.
Mr. Richard H. Nurse, Consultant to the Plastics Industry
Mr. Raymond Pellerin, Nypro, Inc.
Mr. Rob Peterson, 3M
Ms. Paula Puglia, Digital Equipment Corporation
Mr. Richard Quigley, Boston Scientific
Mr. John E. Quinn, General Electric Co.
Mr. I. Sammy Rabinovic, Rohm & Haas Co.
Mr. Venkat Reddy, Ford Motor Company
Mr. Norm Rei, Morton Thiokol, Inc.
Mr. Phillip Rorabaugh, Deerfield Urethane
Mr. Dominick V. Rosato, Consultant
Mr. Andy Routsis, A. Routsis Associates, Inc.
Mr. William Sacks, The Plastics Institute of America, Inc.
Mr. Suresh Shah, Inland Fisher Guide
Mr. John Shaughnessy, Consultant
Mr. Robert Shaw, Shaw Intercontinental Corp.
Mr. Joseph Skornicka, Saturn Division of General Motors

Mr. Robert P. Skribiski, Baxter Healthcare Corp.
Mr. Todd St. Germain, Commercial Plastics and Supply Corp.
Mr. Jerry L. Sturdivant, Saturn Division of General Motors
Mr. Mark Toussaint, Moldflow
Mr. Jim Tully, Central Mass. Mfg. Partnership
Mr. Enio Velazco, Nypro, Inc.
Mr. Bert Vermeulen, PLASCO, Inc.
Mr. Dennis Wolz, Dow Chemical Co.
Mr. Ralph Emerson Wright, Sr., Consultant

Faculty**Dean of the College**

Krishna Vedula, B. Tech., M.S., Ph.D.

Department Heads

Struan R. Robertson, B.S., M.S., Ph.D., P.E., Mechanical Engineering
Alfred A. Donatelli, B.S., M.S., Ph.D., Chemical Engineering
Robert E. Nunn, B.Sc., D.I.C., Ph.D., P.E., Plastics Engineering
Donald S. Pottle, B.S.E., M.S.E., P.E., Engineering Technology
Michael A. Fiddy, B.Sc., Ph.D., Electrical Engineering
William B. Moeller, B.S., M.S., Ph.D., P.E., Civil Engineering
David H. Wegman, B.A., M.S., M.D., Work Environment

Resident Faculty

Carol Barry, Assistant Professor, Plastics Engineering; B.S., Boston College; D.Eng., University of Massachusetts Lowell
Francis J. Bonner, Professor, Chemical Engineering; S.B., S.M., Massachusetts Institute of Technology; Ph.D., University of Delaware; Fil. lic. (Swedish middle degree), Fil. Dr. (Swedish Ph.D.), University of Uppsala, Sweden.
Gilbert Brown, Professor, Nuclear Engineering; B.S., Cornell University; M.S., Ph.D., Massachusetts Institute of Technology.
Clifford J. Bruell, Associate Professor, Civil Engineering; B.S., Lowell Technological Institute, M.S., University of Lowell; Ph.D., University of Connecticut.
Bryan O. Buchholz, Assistant Professor, Work Environment; B.S.E., M.S., M.S.E., Ph.D., University of Michigan.
Majid Charmchi, Associate Professor, Mechanical Engineering; B.S., Arya-Mehr University of Technology; M.S., Ph.D., University of Minnesota.
Kavitha Chandra, Assistant Professor, Electrical Engineering; B.S., Bangalore University; M.S., D.Eng., University of Massachusetts Lowell

Julie Chen, Associate Professor, Mechanical Engineering; B.S., M.S., Ph.D., Massachusetts Institute of Technology

George P. Cheney, Associate Professor, Electrical Engineering; B.S., M.S., Lowell Technological Institute.

Donn A. Clark, Associate Professor, Electrical Engineering; B.S., Pennsylvania State University; M.S. Northeastern University, P.E.

David Colling, Associate Professor, Engineering Technology; S.B., S.M., Sc.D., Massachusetts Institute of Technology; P.E.

Aldo M. Crugnola, Professor, Plastics Engineering; A.B., Boston University; M.S. Northeastern University; Sc.D., Massachusetts Institute of Technology; P.E.

Rudolph D. Deanin, Professor, Plastics Engineering; A.B., Cornell University; M.S., Ph.D., University of Illinois.

Robert J. Dirkman, Associate Professor, Electrical Engineering; B.S., Tufts University; S.M., Massachusetts Institute of Technology.

Alfred A. Donatelli, Associate Professor, Chemical Engineering; B.S., M.S., Lowell Technological Institute; Ph.D., Lehigh University.

Stephen B. Driscoll, Professor, Plastics Engineering; B.S., M.S., Lowell Technological Institute

John J. Duffy, Associate Professor, Mechanical Engineering; B.S., Christian Brothers College; M.S., Illinois Institute of Technology; D.Sc., Washington University, St. Louis, MO; P.E.

Ellen A. Eisen, Professor, Work Environment; B.S., University of Michigan; M.S., Massachusetts Institute of Technology; M.S., Sc.D., Harvard School of Public Health.

Michael J. Ellenbecker, Professor, Work Environment; B.E.E., University of Minnesota; M.S., University of Wisconsin; M.S., Sc.D., Harvard School of Public Health.

Susan Faraji, Associate Professor, Civil Engineering; B.S., Arya-Mehr University of Technology; M.S., Northeastern University; Ph.D., University of Massachusetts.

Michael A. Fiddy, Professor, Electrical Engineering; B.Sc., Ph.D., University of London.

Nathan Gartner, Professor, Civil Engineering; B.S., M.S., Sc.D., Technion-Israel Institute of Technology.

Kenneth Geiser, Associate Professor, Work Environment; B.Arch., University of California, Berkeley; M.C.P., Ph.D., Massachusetts of Technology.

Steven J. Grossman, Professor, Plastics Engineering; B.S., University of Connecticut; Ph.D., University of Massachusetts.

William T. Hogan, Professor, Mechanical Engineering; B.S., Northeastern University; S.M., D.Sc., Massachusetts Institute of Technology; P.E.

F. Ross Holmstrom, Professor, Electrical Engineering; B.S., University of Washington; M.S., Ph.D., Stanford University.

Jan-Chan Huang, Professor, Plastics Engineering; B.S., National Taiwan University; Ph.D., University of Wisconsin.

Hilary I. Inyang, Associate Professor, Civil Engineering; B.Sc., University of Calabar, Nigeria; B.S., M.S., North Dakota State University; Ph.D., Iowa State University

Paul A. Kales, Associate Professor, Engineering Technology; B.S., M.S., Northeastern University.

Dikshitulu K. Kalluri, Professor, Electrical Engineering; B.E., Andhra University; M.S., University of Wisconsin; D.I.I.Sc., Indian Institute of Science; Ph.D., University of Kansas.

Robert A. Karasek, Professor, Work Environment; B.A., Princeton University; M.A., University of Pennsylvania; M.S., Ph.D., Massachusetts Institute of Technology.

David Kriebel, Associate Professor, Work Environment; B.S., University of Wisconsin (Green Bay); M.S., Sc.D., Harvard School of Public Health.

Venkatarama Krishnan, Professor, Electrical Engineering; B.Sc., Madras University; B.Sc., Banaras Hindu University (India); M.S.E., Princeton University; Ph.D., University of Pennsylvania

Walter S. Kuklinski, Associate Professor, Electrical Engineering; B.S., Lowell Technological Institute; M.S., Ph.D., University of Rhode Island

William Kyros, Professor, Mechanical Engineering; B.S., University of Lowell; S.M., Massachusetts Institute of Technology; Ph.D., Cornell University; P.E.

Fang S. Lai, Professor, Plastics Engineering; B.S., National Taiwan University; M.S., University of Notre Dame; Ph.D., Kansas State University.

Earle R. Laste, Jr., Professor, Electrical Engineering; B.S., M.S., Northeastern University; Ph.D., Worcester Polytechnic Institute.

Donald G. Leitch, Professor, Civil Engineering; B.S., Lehigh University; M.S., University of Colorado; P.E.

John P. Leonard, Associate Professor, Electrical Engineering; B.S., Lowell Technological Institute; M.S. Northeastern University.

Charles Levenstein, Professor, Work Environment; B.S., Cornell University; Ph.D., Massachusetts Institute of Technology; M.O.S.H., Harvard School of Public Health.

Robert A. Malloy, Associate Professor, Plastics Engineering; B.S., M.S., Ph.D., University of Lowell.

Stephen R. McCarthy, Professor, Plastics Engineering; B.S., Southeastern Massachusetts University; M.S., Princeton University; Ph.D., Case Western Reserve University.

John W. McKelliget, Associate Professor, Mechanical Engineering; B.Sc., Exeter University, U.K.; Ph.D., Sunderland Polytechnic, U.K.

Ann M. Mescher, Assistant Professor, Mechanical Engineering; B.S., M.S., Ph.D., Ohio State University

Samson Mil'shtein, Professor, Electrical Engineering; M.Sc., State University Odessa, USSR; Ph.D., University of Jerusalem, Israel.

Babak Minaie, Assistant Professor, Mechanical Engineering; B.S., Arya-Mehr University of Technology, Tehran; M.S., Iowa State University of Science and Technology, Ames; Ph.D., University of Minnesota at Twin Cities, Minneapolis

Alan Mironer, Professor, Mechanical Engineering; B.S., B.M.E., Rensselaer Polytechnic Institute; M.Eng., Yale University; Ph.D., Syracuse University; P.E.

COLLEGE OF ENGINEERING*Faculty*

Nancy T. Miu, Associate Professor, Electrical Engineering; M.S.E.E., North Dakota State University; B.S.E.E., National Taiwan University; P.E.

William B. Moeller, Professor, Civil Engineering; B.S., Villanova University; M.S., Ph.D., University of Connecticut; P.E.

Rafael Moure-Eraso, Associate Professor, Work Environment; B.Ch.E., University of Pittsburgh; M.Ch.E., Bucknell University; M.S., Ph.D., University of Cincinnati.

Eugene E. Niemi, Jr., Professor, Mechanical Engineering; B.S., Boston University; M.S., Worcester Polytechnic Institute; Ph.D., University of Massachusetts; P.E.

Robert E. Nunn, Professor, Plastics Engineering; B.Sc., London University, D.I.C., Imperial College, Ph.D., London University; P.E.

John C. O'Callahan, Professor, Mechanical Engineering; B.S., M.S., Ph.D., Northeastern University; P.E.

Stephen A. Orroth, Jr., Professor, Plastics Engineering; B.S., M.S., Lowell Technological Institute.

Charles R. Ott, Professor, Civil Engineering; B.S., M.S., Ph.D., University of Washington; P.E.

Samuel Paikowsky, Associate Professor, Civil Engineering; B.S., M.S., Technion-Israel Institute of Technology; Sc.D., Massachusetts Institute of Technology.

Robert E. Parkin, Professor, Mechanical Engineering; B.Sc., University of London; Ph.D. and D.I.C., Imperial College, University of London.

Martin A. Patt, Associate Professor, Electrical Engineering; B.S., Northeastern University; S.M., Massachusetts Institute of Technology.

Stephen P. Petrie, Professor, Plastics Engineering; B.S., Lowell Technological Institute, M.S., Lowell Technological Institute, Ph.D., University of Connecticut.

Donald S. Pottle, Professor, Engineering Technology; M.S.E., B.S.E., Northeastern University; P.E.

Drew Pommet, Assistant Professor, Electrical Engineering; B.S., M.S., University of Massachusetts Lowell; Ph.D., University of Central Florida.

Kanti Prasad, Professor, Electrical Engineering; B.S., Agra University (India); B.E., University of Roorkee; Ph.D., University of South Carolina; P.E.

Laura Punnett, Associate Professor, Work Environment; B.A., Hampshire College; M.S., Sc.D., Harvard School of Public Health.

Margaret M. Quinn, Assistant Professor, Work Environment; B.A., Brown University; M.Sc. Industrial Hygiene, M.Sc. Physiology, Harvard University; Sc.D., University of Massachusetts Lowell.

Tenneti C.K. Rao, Associate Professor, Electrical Engineering; B.S. Andhra University; B.S., M.E., Ph.D., Indian Institute of Science, Bangalore (India).

Struan R. Robertson, Professor, Mechanical Engineering; B.S., M.S., Clarkson University; Ph.D., Rensselaer Polytechnic Institute; P.E.

James H. Rome, Associate Professor, Electrical Engineering; B.S., M.S., University of Michigan; Ph.D., University of Pennsylvania.

Ziyad Salameh, Professor, Electrical Engineering; M.Sc., Ph.D., University of Michigan.

Gary S. Sales, Associate Professor, Electrical Engineering; B.S., Brooklyn College; M.S., Ph.D., Pennsylvania State University.

Dominick A. Sama, Professor, Chemical Engineering; S.B., S.M., Sc.D., Massachusetts Institute of Technology.

Nick R. Schott, Professor, Plastics Engineering; B.S., University of California, Berkeley; M.S., Ph.D., University of Arizona.

Burton A. Segall, Professor, Civil Engineering; B.C.E., Polytechnic Institute of Brooklyn, M.S.C., University of North Carolina; M.P.H., University of North Carolina; Ph.D., New York University; P.E.

James R. Sheff, Professor, Nuclear Engineering; B.S., University of Colorado; M.S., Ph.D., University of Washington; P.E.

James A. Sherwood, Assistant Professor, Mechanical Engineering; B.S., M.S., Ph.D., University of Cincinnati.

Sammy G. Shina, Associate Professor, Mechanical Engineering; B.S.E.E., B.S.I.T., Massachusetts Institute of Technology; M.S., Worcester Polytechnic Institute; P.E.

David R. Smith, Assistant Professor, Mechanical Engineering; B.S., M.S., Ph.D., Georgia Institute of Technology.

Stephen J. Spurk, Associate Professor, Electrical Engineering; B.S., Merrimack College; M.S., University of New Hampshire.

Ross G. Stacer, Assistant Professor, Plastics Engineering; B.A., University of California, Irvine; Ph.D., University of Akron.

Chronis Stamatiadis, Assistant Professor, Civil Engineering; B.S., Aristotelian University of Thessaloniki, Greece; M.S., Ph.D., Michigan State University.

Changmo Sung, Associate Professor, Nuclear Engineering; B.S., M.S., Seoul National University, Korea; M.S., Ohio State University, Columbus; Ph.D., Lehigh University.

Randall W. Swartz, Associate Professor, Chemical Engineering; B.S., Rensselaer Polytechnic Institute; Associate Professor, Chemical Engineering; M.B.A., Indiana University/Purdue University at Indianapolis; Ph.D., Rensselaer Polytechnic Institute.

Amad Tayebi, Professor, Plastics Engineering; B.S., Alexandria University (Egypt); M.S., M.E., Sc.D., Massachusetts Institute of Technology.

Charles Thompson, Professor, Electrical Engineering; B.E., New York University; M.S., Polytechnic University; Ph.D., Massachusetts Institute of Technology.

John M. Ting, Professor, Civil Engineering; Associate Professor; B.S., McGill University, Montreal; M.S., California Institute of Technology; Sc.D., Massachusetts Institute of Technology; P.E.

Anh Tran, Associate Professor, Electrical Engineering; B.Sc., National Taiwan University; M.S., Ph.D., University of Rhode Island.

Robert J. Tuholski, Associate Professor, Engineering Technology; B.S., Fitchburg State College; M.Ed., Ph.D., University of Maryland.

Thomas Vasilos, Professor, Chemical Engineering; B.S., Brooklyn College; Sc.D., Massachusetts Institute of Technology.

Krishna Vedula, Professor, Chemical Engineering; B.S. I.I.T Bombay; M.S. Drexel University; Ph.D., Michigan Technical University.

Fahd G. Wakim, Associate Professor, Electrical Engineering; B.S., American University of Beirut; M.A., Ph.D., University of Texas.

John W. Walkinshaw, Professor, Chemical Engineering; B.S., M.S., Lowell Technological Institute; Ph.D., University of Manchester (England); P.E.

David H. Wegman, Professor, Work Environment; B.A., Swarthmore College; M.S., Harvard School of Public Health; M.D., Harvard Medical School

Jay A. Weitzen, Associate Professor, Electrical Engineering; B.S., M.S., Ph.D., University of Wisconsin.

John R. White, Professor, Nuclear Engineering; B.S., University of Lowell; M.S., Ph.D., University of Tennessee.

Susan R. Woskie, Assistant Professor, Work Environment; B.S. University of Massachusetts, Amherst; M.S., Harvard School of Public Health; Ph.D., Clark University.

A. David Wunsch, Professor, Electrical Engineering; B.E.E., Cornell University; S.M., Ph.D., Harvard University.

Yakov M. Zilberberg, Associate Professor, Mechanical Engineering; M.S., Technical Institute, Odessa, (USSR); Ph.D., University of New Hampshire; P.E.



College of Fine Arts



The College of Fine Arts provides intensive training in the arts through a variety of undergraduate degree programs and concentrations in art and music. The College offers three baccalaureate degrees: Bachelor of Fine Arts in Graphic Design or Fine Arts; Bachelor of Music in Music Education, Performance, Music Business, Sound Recording Technology, and Bachelor of Arts in Music.

The programs in music and art are committed to the University's mission of reaffirming teaching and learning, embracing diversity and pluralism, and pioneering the interactive university. The Music Department is dedicated to the pursuit of excellence in teaching and learning, to the quality of its educational programs through teaching and research, to the artistic level of its concert and recording activities, and contributes significantly to the quality of life in the University's regional and global communities through public performances and distance learning.

The programs for the art major offer students the opportunity to prepare for careers in fine arts, commercial art, gallery work, museum research, photography, teaching, and graduate studies in art related fields.

The Bachelor of Music programs afford students the opportunity to prepare for careers in teaching, performance, music management, and recording. The Bachelor of Arts program offers students interested in careers in music history, music theory and composition, or related fields such as music library science, arts management, thorough preparation for the required postgraduate work. The programs in music business, music education and sound recording technology require an internship in the final semester.

The University of Massachusetts Lowell is a full member of the National Association of Schools of Music and an Associate Member of the National Association of Schools of Art and Design. All degree programs offered by the College of Fine Arts are in compliance with the standards of these accrediting agencies.

In addition, the Bachelor of Music in Music Education degree program is accredited by NCATE.

Gerald J. Lloyd, Dean

COLLEGE OF FINE ARTS

College Policies and Requirements

Community Outreach Division

The College of Fine Arts Community Outreach Division presents a Family Discovery Series of professional touring events in theatre, dance, and music for children ages 4-14 and their parents, as well as the SMARTS (Students Meeting the Arts) series for school groups in grades K-8. Events are presented in Durgin Hall on the south campus which contains a 980 seat theatre. Each year selected performing artists are presented in Lowell area schools. The division also offers the Arts Bridge series of professional development workshops for teachers on integrating the arts into all areas of the school curriculum. Arts Bridge was developed in partnership with the Kennedy Center for the Performing Arts in Washington, D.C.

Objectives of the College of Fine Arts

The College of Fine Arts:

1. provides students majoring in art or music with a strong theoretical, historical, and cultural knowledge base as a foundation for upper division studies;
2. balances the theoretical and historical bases of each arts concentration with appropriately rigorous applied study in the art medium;
3. provides a strong program of core requirements in the arts and sciences; and
4. provides, in some degree concentrations, an internship experience in a highly competitive professional environment often leading to career opportunities immediately upon graduation.

College Organization and Governance

The College of Fine Arts is administered by a dean and is organized into two departments: art and music. Each department is responsible for developing its course offerings and programs of study, and the art or music faculty, as a whole, is responsible for academic policies.

Chairpersons

Fred Faudie, Art

Anthony Mele, Music

Coordinators of Music Areas

Scott Fredrickson, Music Business

William Moylan, Sound Recording Technology

John Ogasapian, Music History

Rosita Sands, Music Education

Anne Trenkamp, Bachelor of Arts/Music

Applied Area Heads

Jeffrey Fischer, Percussion

David Martins, Woodwinds

Ivan Oak, Voice

Kay George Roberts, Strings

Willis Traphagan, Brass & Percussion

Juanita Tsu, Keyboard

Jonathan Wheatley, Guitar

Baccalaureate Degree Programs

Bachelor of Arts Degree with a Major in Music

The Bachelor of Arts degree with a major in music is the study of music within the context of a liberal, rather than a professional, education. The Bachelor of Arts degree is intended for the student who has a general interest in music and wishes to secure a broad, comprehensive education or desires to combine his or her music studies with some other major or minor academic field. The requirements for majors are set by university departments but must specify a minimum of 30 semester credits. Although students may not be required to take more than 45 semester credits in the major field, they may elect to take additional courses in the major field beyond the specified required maximum. At least 15 credits in the major field must be taken at the upper division course level. Bachelor of Arts degree programs require a minimum of 75 semester credits outside the major field, except as specified by provisions concerning second majors.

Music majors who are candidates for the Bachelor of Arts degree in the College of Fine Arts may elect a second major offered by another college of the University. For a full discussion of University requirements concerning second majors, students should consult the applicable section of this publication which appears under the heading "Academic Policies."

In accordance with the requirements of established minor programs, music majors who matriculate for the degree of Bachelor of Arts may undertake a minor, offered by another college of the University. Students who are interested in such programs should refer to the appropriate chapters which detail the programs of other colleges.

Music majors who do not desire second majors or minor programs may complete their Bachelor of Arts requirements through a program of elective courses. Such elective programs may not be taken in the College of Fine Arts and must be approved by the student's faculty advisor. When presented in fulfillment of collateral degree requirements without a second major or a minor, the program of elective courses must include at least six credits of courses which are on or above the 300 course level.

Bachelor of Music Degree

Music majors pursuing the Bachelor of Music degree are preparing for a career in music. The Bachelor of Music degree offers two areas of specialization: music education and performance. Areas of emphasis of the performance specialization include sound recording technology and music business. The music education specialization is designed to prepare teachers and supervisors of music in the elementary and secondary schools. The specialization in performance provides opportunities for individual performance, research, and creativity to students who wish to obtain professional careers in music. Programs combining two areas of specialization, e.g., music education/performance, are also available. A student desiring to pursue such a combined course of study must satisfy the requirements in both areas and should plan to spend one or more semesters in residence beyond the normal eight semesters of full-time study required for the successful completion of a program with a single area of specialization.

Individual and group performances are important aspects of all Bachelor of Music programs; students in the performance specialization, however, are required to demonstrate outstanding ability as performers in order to satisfy admission and retention standards. Students preparing for admission to the music education specialization are required to select applied music courses (private lessons) each semester for maintaining and developing their music skills, and they are expected to develop minimum standards of performance in piano and in their areas of performance emphasis.

The music education specialization is subject to the same rules and regulations as those which govern all teacher education programs of the University.

All Bachelor of Music candidates must participate in one two-credit or two one-credit ensemble(s) during each semester of their residence as full-time students, unless otherwise specified.

Music Minor Programs

The College of Fine Arts offers non-music majors in the University the music minor programs which consist of 18-24 credit hrs. approved by a music advisor. Students wishing to minor in music should see the Chairperson of the Music Department for assignment to a faculty advisor.

Sound Recording Technology (Music) Minor Programs

For Students Majoring in Electrical Engineering

This supportive minor in sound recording technology applies to electrical engineering majors only. Application for admission into the minor sequence of study requires a petition to be submitted to the Coordinator of Sound Recording Technology after the completion of 71.100 (Fundamentals of Musicianship), 75.131 (Intro to Keyboard), 78.310 (Intro to Recording), and before other related course work.

Basic Music Requirements

Eleven credit hours:

- 71.100 Fundamentals of Musicianship
- 75.131 Intro to Keyboard I

- 71.306 Aural Perception of Timbre & Space
- 71.390 Physical Acoustics & Psychoacoustics

Sound Recording Technology

Nine credit hours:

- 78.310 Introduction to Recording
- 78.411 Recording Technology II
- 78.470 Recording Studio Repair & Maintenance

Three credit hours from the following:

- 78.350 Video Production
- 78.420 Sound Synthesis I
- 78.430 Computer Applications in Music
- 78.450 The Recording Industry
- 78.490 Seminar in SRT Technical Research

Electrical Engineering

At least one electrical engineering "technical elective" should be directly applicable to the discipline of sound recording technology.

Total: 23 credits

For Students Majoring in Computer Science

Basic Music Requirements

Eleven credit hours:

- 71.100 Fundamentals of Musicianship
- 75.131 Intro to Keyboard I
- 71.306 Aural Perception of Timbre & Space
- 71.390 Physical Acoustics & Psychoacoustics

Sound Recording Technology

Nine credit hours:

- 78.310 Introduction to Recording
- 78.420 Sound Synthesis I
- 78.490 Seminar in SRT Technical Research

Three credit hours from the following:*

- 78.350 Video Production
- 78.411 Recording Technology II
- 78.421 Sound Synthesis II
- 78.450 The Recording Industry

Total: 23 credits

*Elective courses are determined through discussions between the student and the Coordinator of Sound Recording Technology

General College Requirements

In order to qualify for a baccalaureate degree offered by the College of Fine Arts, undergraduates must comply with the University general education requirements, must conform to the requirements of the College of Fine Arts which govern degrees and major studies for such degrees, and must earn at least a 2.000 average in their major concentrations of specialization by the end of the senior year. Additional requirements are specified for retention in specific degree programs.

Students who have failed to achieve at least a 2.000 average in their major concentrations or other specific, stated retention standards of their degree specialization by the end of the junior year and have not made satisfactory progress toward their degrees may be placed on probationary status in the College, be disenrolled from the College, or dismissed from the University for inadequate scholarship.

Language Proficiency

Vocal performance majors are required to complete two consecutive semesters of the same foreign language, plus 75.261 Diction for the Singer I (English and German), and 75.262 Diction for the Singer II (Italian and French).

Students who anticipate graduate work in such areas as music history and literature are strongly encouraged to develop proficiency during their undergraduate enrollment.

Declaration of Major

Music majors are accepted into their intended majors conditionally. They must officially apply to their program of choice. See specific major for requirements and deadlines.

COLLEGE OF FINE ARTS*College Policies and Requirements***Change of Major**

Students who wish to change their major from art or music to another major outside the College of Fine Arts must file for intercollegiate transfer within the University (cf. Transfer Policies) and secure the approval of the appropriate chairperson. Students who wish to change their major within the College of Fine Arts must secure the approval of the Chairperson of the Music Department and the Coordinator of the program to which they are requesting transfer. All such changes of program require that the form for declaration of major or change of major be filed with the Office of Enrollment Services.

Transfer Policies

Students transferring to the College of Fine Arts from other colleges of the University or from other institutions may expect recognition of previously completed courses if these are equivalent to those which are specified by curricula of the College. Students wishing to transfer to Bachelor of Music programs are required to demonstrate their vocal or instrumental ability during an audition before the Faculty of the College and complete placement testing in music theory.

Transfer from Other Institutions

Courses which are transferred from other institutions are initially evaluated by the Office of Admissions in terms of general University requirements. In addition, courses which are presented for transfer are evaluated by professional departments in terms of College and program requirements at the time a student is accepted for matriculation in the College of Fine Arts. Courses which are transferred to the University under provisions of the Commonwealth Transfer Compact and which are not creditable to requirements of the College of Fine Arts or as unrestricted elective courses will be listed on the student's permanent record card, but will not apply to the minimum degree requirements. In the event that a student who has transferred to the University under the Commonwealth Transfer Compact subsequently makes an intercollegiate transfer to the College of Fine Arts, all previously completed courses will be reevaluated in terms of their applicability to degree requirements of the College of Fine Arts.

Repetition of Transferred Courses

A student who has been granted transfer credit and has been assigned to advanced courses for which the transferred course is a prerequisite, may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred when the competence of the student has been demonstrably inadequate. Permission to repeat a transferred course is granted by filing an academic petition form with the Office of the College Dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

Intercollegiate Transfer to the College of Fine Arts

Students wishing to transfer from another college of the University must file a request and submit an updated transcript to the Department Chairperson and the Dean of the College of Fine Arts by November 1 for spring semester and by April 1 for fall semester transfer. The student must have a minimum grade point average of 2.000 and is subject to the same auditioning process as incoming new students. Students are referred to University policies concerning intercollegiate transfer which appear elsewhere in this publication under the heading "Academic Policies: Change of Major with Intercollegiate Transfer" for further procedural details. Records of students who are approved for transfer are reviewed by the Office of the Dean. All courses which may not be applied to College or program requirements are deleted from the students cumulative grade-point average, irrespective of grades received in other college programs.

Applied Music

All Bachelor of Music degree students in the music education specialization must successfully complete eight semesters of applied music (private lessons) on their principal instrument, earning no less than 16 credits toward graduation. The performance specialization requires eight semesters of study and a public senior recital for a total of 23 credits in applied music. Music Business students are required to

take seven semesters, and sound recording technology are required to take six semesters of applied music (private lessons). An evaluation by a faculty panel is required of all full-time undergraduate music students each semester, with the exception of the first semester of the freshman year. Studio grades are submitted to the faculty panel prior to the evaluation. In computing the final grade, the faculty evaluation panel may raise or lower the studio grade by a maximum of one full letter grade, or the panel may allow the studio grade to stand as submitted. Any student who fails to perform for the faculty panel because of an unexcused absence will receive a final semester grade of F.

Any student enrolling for applied music beyond the credits required for his or her respective degree and major must do so through the Division of Continuing Education.

Panel (Jury) Evaluations

With the exception of first semester freshmen, all undergraduate students play a panel evaluation each semester of residency. In the semester that a required recital is performed, the student is exempted from a panel evaluation.

Recital Attendance Requirement

All undergraduate music majors in the College of Fine Arts are required to attend ten concerts and/or recitals each semester from among those listed on the College Performance Calendar. In addition, attendance at scheduled recital hours at noon on Thursdays is required.

Seven satisfactory semesters of recital attendance are required of each undergraduate student with the following exceptions: 1) students who are in residence fewer than seven semesters and transfer students must fulfill the recital attendance requirement for each semester of residence as full-time matriculated degree students; and 2) part-time students have no requirement.

Failure to complete the total recital attendance requirement will result in denial of graduation.

Ensemble Requirements (Auditions)

All music students must audition for ensemble assignment during the first week of the fall semester. Auditions are held during the first week of the spring semester for all new music students, transfers and re-admitted students. Students who do not qualify for a two-credit ensemble are assigned to two one-credit ensembles. Ensemble assignments are usually for the academic year.

Music students who elect to participate in Marching Band or Jazz Rock Big Band must also audition for assignment to an appropriate choral or instrumental ensemble.

Ensemble Requirements (Participation)

All music students are required to be enrolled, as assigned, in two credits of ensemble for each semester in which they are full-time students. Music Education majors are exempt from the ensemble requirement during the semester they are enrolled in Apprentice Teaching.

Vocal majors will be assigned to a choral ensemble. Wind, string, brass and percussion majors will be assigned to an instrumental ensemble. Keyboard (piano and organ) and guitar majors will be assigned to an ensemble that emphasizes their major instrument such as Guitar, Piano or Mixed Chamber Ensemble and possibly to a choral or instrumental ensemble.

Bachelor of Arts music majors are encouraged to register for two credits of ensemble each semester they are enrolled as full-time music majors, but these credits are not automatically applied toward the degree. Bachelor of Arts students may take up to six credit hours of either ensemble or applied music toward the Bachelor of Arts music major.

Student Recitals

Students in the performance major are required to present a senior recital, usually while enrolled in Performance Applied VI. Students may petition the Department Chairperson for permission to present the senior recital one semester early, during Performance Applied V. Students in other specializations may also present public recitals. In all cases, students wishing to present a recital must receive recital per-

mission from the applied music instructor, the appropriate applied music area head and the Music Department Chairperson. A recital permission form may be obtained from the Dean's office and must be submitted no later than November 15 in the fall semester and March 15 in the spring semester.

Art Department

Chairperson: Fred Faudie

Professors: Fred Faudie, Arno Minkinen, and Brenda Pinardi

Associate Professors: James Coates and James Veatch

Professors Emeritus: Robert Griffith and Carleton Plummer

Art Major

The art major is designed to develop a discriminating appreciation of art and a knowledge of the technical requirements for creating art works. In order to foster these abilities and to promote analytical and aesthetic understanding, the program provides a foundation in both the theoretical and practical aspects of art. The Art Department offers the professional degree of Bachelor of Fine Arts. It also offers a major in art leading to the Bachelor of Arts degree. The department offers minor programs in studio art. A major in art provides students the opportunity to prepare for careers in fine arts, computer-based illustration and graphic design, community oriented art programs, gallery work, museum research, photography related occupations, teaching, and graduate study in art.

Accreditation

The Art Department of the University of Massachusetts Lowell is an accredited member of the National Association of Schools of Art and Design.

Bachelor of Fine Arts: Major Requirements

This program is designed for students who seek knowledge of the basic art processes and an opportunity to develop concentrated skills in an area of concentration within the Fine Arts or Graphic Design degree areas. By pursuing art under this program, the student prepares for specific art careers and for graduate study in studio art. The total of art studies cannot exceed 87 credits unless the student presents additional non-art credits equal to the number of credits by which the art credits exceed the 87 art credit maximum. A min-

COLLEGE OF FINE ARTS*Art Department*

imum of 33 credits must be presented in non-art courses.

BFA studies consist of 75 studio credits and must include at least five courses (15 credits) at the 300 level or above, plus the following requirements:

1. Eight Studio Foundation courses (24 credits): Drawing I and II, 2D Design and 3D Design, Painting I, Photography I, Computer Art I, Sculpture;
2. Ten required courses within the chosen concentration of Fine Arts or Graphic Design (30 credits):

The following are sample programs; actual programs are individually structured with the aid of the student's academic advisor and the permission of the Senior Studio Review Committee.

Fine Arts Concentration

- 70.259 Papermaking
- 70.267 Printmaking
- 70.273 Watermedia
- 70.361 Photography II
- 70.369 Monotypes
- 70.370 Figure Drawing
- 70.371 Painting II
- 70.492 Advanced Studio in Area of Concentration
- 70.492 Advanced Studio in Area of Concentration
- 70.494 Directed Studies in Area of Concentration

Graphic Design Concentration

- 70.230 Typography
- 70.361 Photography II
- 70.365 Computer Art II
- 70.372 Cartooning
- 70.373 Professional Photography
- 70.390 Illustration
- 70.395 Advertising Design
- 70.397 Art and Copy
- 70.492 Advanced Studio in Area of Concentration
- 70.496 Practicum Experience in Area of Concentration

3. Two studio elective courses: (6 credits)
4. Senior Studio Requirements (15 credits):

All courses under this requirement must be taken with the advice and consent of the student's academic advisor and of the

Senior Studio Review Committee. Continuation in the BFA program is dependent on approval by the Review Committee at the end of the first 3 credit hours. An exhibition of work is required as part of Senior Studio.

- 70.497.801 3 credit hours
(last semester of junior year)
- 70.497.802 6 credit hours
(first semester of senior year)
- 70.497.802 -6 credit hours
(last semester of senior year)
- 5. Aesthetics and Critical Studies requirements (12 credits):

Survey of Art, Prehistoric to Medieval Art, Survey of Art, Renaissance to Modern and two Aesthetics and Critical Studies elective courses.

Students who wish to pursue the Bachelor of Fine Arts degree must meet the following standards and requirements:

1. Completion of the Art Department foundation studio course requirements (24 credits);
2. Completion of the two course Survey of Art sequence (6 credits);
3. Completion of a combination of upper level studio art courses selected in consultation with their academic advisor and which are appropriate to the intended concentration;
4. Maintenance of a semester grade point average of 2.00 for all art courses.
5. Presentation of a portfolio and formal letter of application to the Senior Studio Review Committee at the completion of 75 credits of study. Students who have satisfied these requirements are permitted to enroll in their first course of Senior Studio (3 credits) as a conditional Senior Studio enrollee.

Students matriculated in the BFA program must earn a C (2.0) or better in each enrollment of Senior Studio, and must receive a recommendation for continuance at the end of each semester from the Senior Studio Review Committee. A student who fails to achieve the required grade point average or who is not recommended for continuation by the Senior Studio Review Committee will be dismissed immediately from the BFA program.

Senior Studio courses are, with the exception of the first conditional three credit course, regarded as professional courses and for this reason are restricted to matriculating BFA majors only and may not be credited to any other curriculum. In the event that a matriculating BFA student transfers or is dismissed from the BFA program, semester course credits earned in subsequent Senior Studio courses may not be credited to degree programs either in the Art Department or elsewhere in the University. Senior students should be aware that transferring from the BFA program to another degree major will normally entail a loss of credits and that the completion of degree requirements within the customary four year period may not be possible.

Students admitted to the BFA program are exempt from the language requirement.

Bachelor of Arts: Major Requirements**Studio Art Program**

This program is designed for students who seek both knowledge of the basic art processes and an opportunity to develop skills in studio art with concentrations in areas such as drawing, painting, computer-based illustration and graphic design, photography, mixed media, sculpture, and multi-media. By pursuing an art major under this program the student can prepare for specific art careers and for graduate study. The total of art studies cannot exceed 60 credits unless the student presents additional non-art credits equal to the number of credits by which the art credits exceed the 60 art credit maximum. A minimum of 60 credits must be presented in non-art courses.

The major in studio art which is taken under this concentration consists of 36-45 credits and must include at least five courses (15 credits) at the 300 level within the following requirements:

1. Eight Studio Foundation courses (24 credits) Drawing I and II, 2D Design and 3D Design, Painting I, Sculpture I, Photography I and Computer Art I;
2. Four approved courses in either of the Fine Arts or Graphic Design concentrations (12 credits);

3. Studio Art electives (3-9 credits).
4. Aesthetics and Critical Studies requirement (12 credits): Survey of Art, Prehistoric to Medieval and Survey of Art, Renaissance to Modern (6 credits) and two approved Aesthetics and Critical Studies courses (6 credits)

Double Major Program

This program is humanistic in nature and allows students to major in a collateral area of study. By pursuing a degree program which includes a second discipline, students can prepare for specialized graduate work, such as an art therapy program. A major in art which is taken under this concentration consists of 36-45 credits and must include at least five courses (15 credits) at the 300 level or above plus the following requirements:

1. Five Studio Foundation courses (15 credits) Drawing I, 2D Design, 3D Design, Painting I, Photography I or Computer Art I;
2. Studio Electives (9-18 credits);
3. Four Aesthetics and Critical Studies courses (12 credits) Survey of Art, Prehistoric to Medieval and Survey of Art, Renaissance to Modern, and two other Aesthetics and Critical Studies elective courses.

Portfolio Requirements

Unlike many art schools who do not require portfolios, we recommend one to properly place new students in their course sequence. A portfolio is required for transfer students to determine which courses and credits the department can credit toward a University of Massachusetts Lowell degree. Slides should be individually labeled and should be submitted in twenty slide sheets and consist of representative samples of work executed in high-school or at the student's previous institution.

Minor Requirements

A minor in studio art consists of 18-24 credits selected in accordance with the following specifications: 15-21 credits must be completed in studio art courses and at least one Aesthetics and Critical Studies course must be completed. No fewer than

six semester credits of the minor must be at the 300 level or above.

European Summer Program

The Art Department offers photography courses for credit in various countries in Europe during the summer. The courses generally take place in Finland, France, and Eastern Europe.

Student Policies

Registration for Art Courses

The Art Department reserves the right to pre-register its major students in order to assure completion of their degree requirements. In the event of over-subscription of art courses by art majors, the department will grant first preference to seniors and second preference to juniors.

Policy Concerning Student Work

The Art Department reserves the right to keep student work for a period not to exceed one year for inclusion in exhibitions. The department reserves the right either to photograph student work for its slide collection or, in the case of photography, printmaking and computer courses where many copies can be made, to keep actual examples of work. Unless otherwise specified, art work and term papers left for more than one semester following the semester in which they were completed become the property of the Department.

Senior Studio students must submit visual documentation of their course work; this documentation becomes part of their department records.

Academic Integrity

Students should be aware of the issues of creative honesty and of the prohibition against the unwarranted use of the work of others, of the dishonesty of misrepresenting the source of work and ideas, and of the penalties established by the University for cheating and plagiarism. The department expects that work passed in by the student will be the product of the student's own effort. Particulars of the University policy on academic dishonesty can be found elsewhere in this bulletin.

Equipment Care and Replacement Repair

The Art Department has limited resources which allow it to provide equipment for student use. Students are responsible for replacement costs of any items which they lose or damage in the course of their studies.

Studio Art (Course Prefix: 70)

70.230 Typography

The study of lettering concepts and techniques, including the history of letters, styles and families of type, letter design, hand-drawn to computer-based lettering approaches and their effect and uses in communication. Emphasis will be on creative and aesthetic communication. 3 cr.

70.251 2D Design

A study of two-dimensional design principles and how they articulate structure, space and form. The development of visual ideas that relate to painting, sculpture, graphic arts and architecture. 3 cr.

70.253 3D Design

A study of the visual elements and the basic design principles involved in the composition of three-dimensional objects. Emphasis will be placed on materials exploration, the development of problem-solving skills, perception, awareness and sensitivity to our visually, object-oriented environment. 3 cr.

70.255 Drawing I

A foundation course in basic drawing concepts using a variety of media and approaches. The emphasis is on building visual literacy and its application to the realm of ideas. A wide range of assignments is given to develop graphic expression. 3 cr.

70.259 Papermaking

The papermaking course is designed to explore paper, not just as a surface to receive an image, but as a material capable of being an artistic expression in and of itself. The course will explore the processes and techniques of making images in handmade paper, making images on handmade paper, making visual designs out of handmade paper and casting handmade paper into three-dimensional sculptural forms. 3 cr.

COLLEGE OF FINE ARTS*Art Department***70.261 Photography I**

A foundation course that covers the basic camera and darkroom techniques as well as aesthetic principles. Emphasis will be on black and white film and paper emulsions. Students learn to develop and print their own photographs. 3 cr.

70.265 Computer Art I

An aesthetics and communications course using the computer as the primary tool for translating art ideas into physical form. The emphasis will be on practical usage of existing Macintosh software as a means of creation. Prerequisite: 70.251 and/or 70.255 or permission of the instructor. 3 cr.

70.269 Color

A course in the systematic study of color and color theory to sharpen visual acuity, stimulate creativity and develop a greater facility in the use of color. 3 cr.

70.267 Printmaking

An introduction to graphic techniques and expression including relief and intaglio processes. The approach is creative rather than directed, emphasizing experimentation and exploration in many areas of printmaking. 3 cr.

70.271 Painting I

Oil painting techniques are taught as vehicles for serious creative expression. A variety of assignments will be given to help build proficiency in the use of color, paint handling, and subject matter. 3 cr.

70.273 Watermedia

The technical and creative use of water based media as they apply to fine arts and graphic design. Assignments in acrylic, gouache, watercolor, and ink are designed to stimulate independent thinking. A final self-assigned project is required. 3 cr.

70.275 Sculpture I

The exploration of three-dimensional form through the use of basic materials, methods and approaches. Assignments will include expressive problems based on human and non-objective form relationships. 3 cr.

70.281 Ceramics I

Ceramics will introduce the student to the basic handbuilding techniques, wheel throwing and ceramic sculpture. The course will also examine clay, the material, glaze techniques and firing processes. 3 cr.

70.299 and/or 70.399 Studio Workshop

Study of studio problems in visual structures and organization with various media and techniques; contemporary practices and issues will be explored. Topics will vary. This course may be repeated. Prerequisite: 70.251, 70.253, and/or 70.255 or permission of instructor. 3 cr.

70.351 Advanced Studies in Visual Design

An advanced study of design principles and how they articulate structure, space and form. The emphasis is on development of a personal approach to design principles. Prerequisite: 70.251 or permission of instructor. 3 cr.

70.355 Drawing II

An advanced course in drawing with an emphasis on giving form to ideas through building a solid sense of visual literacy. Assignments include a wide range of media and subject matter with emphasis on development of color usage and personal style. Prerequisite: 70.255 or permission of instructor. 3 cr.

70.370 Figure Drawing

The study of the draped and undraped figure from life, stressing both sound observation and effective graphic expression. A variety of assignments and approaches will be given in order to help development of personal expression and style. Prerequisite: 70.255 or permission of instructor. 3 cr.

70.359 Sculpture II

A course allowing the student to further develop his or her techniques and understanding of sculptural form, leading to a more personal vocabulary. Conventional techniques will be extended to cover more contemporary materials and methods. Prerequisite: 70.275 or permission of instructor. 3 cr.

70.361 Photography II

An advanced course in black and white photography that includes instruction in technique and vision. Emphasis will be on development of a cohesive body of work in photography. Prerequisite: 70.261 or permission of instructor. 3 cr.

70.365 Computer Art II

Designed to focus on advanced projects using the Macintosh platform. Focus is on design, layout, animation and video. Prerequisite: 70.251, 70.255 and 70.265 or permission of instructor. 3 cr.

70.369 Monotypes

Exploration of the one-of-a-kind "painter's print." Emphasis is on the development of personal expression through a variety of assignments and techniques. Three portfolios of prints are required, two with assigned topics, and one with a self-assigned theme. 3 cr.

70.371 Painting II

Designed to allow students to develop individual style through a variety of problems, both self-initiated and assigned by the instructor. Prerequisite: 70.271 or permission of instructor. 3 cr.

70.372 Cartooning

The course is designed to develop skills and techniques essential for appreciating and producing cartoon forms for publication and advertising. Special topics to be covered are politics, sports, panel humor, advertising, and comic strips. Original cartoon work will be done in black and white, and color; computer output will be explored. Prerequisite: 70.255 or permission of instructor. 3 cr.

70.373 Professional Studio Photography

A professional level course in advertising product and studio portrait photography. Students will learn view camera techniques as well as principles of lighting using strobe equipment. 3 cr.

70.375 The Language of Video

An introductory course in video camera principles and editing functions. Utilizing writing and still photography, students will explore the language of video in both images and sound as they produce factual documents and/or personal fiction. Prerequisite: 42.101, 70.361 or permission of instructor. 3 cr.

70.376 3D Modeling and Animation

Students will learn the fundamentals of computer generated 2D and 3D modeling and animation. Projects will include 3D oriented print ad development and 3D digital animation video clips. Prerequisite: 70.265. 3 cr.

70.379 Visual Content Design for the WEB

This course will focus on creating visual content for WEB home pages. The course will explore what constitutes a visually exciting and engaging site. Students will learn HTML, GIF/JPEG file formats, WEB

color strategies and platform standards.

Prerequisite: Computer Art I or its equivalent or permission of instructor. 3 cr.

70.381 Ceramics II

This course allows students to advance their understanding of basic handbuilding principles while stressing wheel throwing techniques. Students will also be involved in glaze formulation and several kiln firing procedures. Prerequisite: 70.281 or permission of instructor. 3 cr.

70.390 Illustration

This course provides students with a variety of experiences involving skills and techniques including computer use related to the execution of illustrations for children's books, fashion drawings, record albums, book jackets, folders, posters, and magazines. Field trips, discussions related to job opportunities and preparation of portfolios are integral parts of the instruction. Prerequisite: 70.251, 70.255 and/or 70.273 or permission of instructor. 3 cr.

70.395 Advertising Design

Instruction in lettering, layout of commercial media as well as in the creative aspects of advertising are an integral part of the course. Practical problems, field trips, and technical guidance from preliminary layouts to finished work will help prepare students for the commercial art field. Prerequisite: 70.230, 70.251, 70.255, and/or 70.261 or permission of instructor. 3 cr.

70.398 Art and Copy

The real world of advertising incorporates selling words and memorable images in a dynamic visual/verbal design unit. As copywriters and art directors, students learn to think pictures and see words as they prepare advertising campaign concepts for a variety of products and media, including print and television. Prerequisite: 70.230, 70.251, 70.255 and/or 70.261 or permission of the instructor. 3 cr.

70.398 The Documentary Image

In a world of increasing manipulation, documentary photographs still astound us with their visual truths. In this course, students will utilize words and images - the primary tools of the photo journalist - to explore the significant issues of our time. Works by Fenton, O'Sullivan, Gardner, Riis, Hine, Bourke-White, Lange, Smith, Davidson, Salgado, Mark and others are studied for content, style, and inspiration. Prerequisite: 42.102 and 70.261 or permission of the instructor. 3 cr.

70.492 Advanced Studio

In order to enable students to expand expression in areas of their choice, they may repeat any studio course that is the most advanced offered in that given subject. They will be given more freedom within assignments and be expected to perform on a more advanced level. Prerequisite: permission of instructor. 3 cr.

Individual Studies

Individual study courses are available only to art majors and may be elected provided that 1) the material to be covered is not available in departmental course offerings, 2) instructor is willing to undertake a directed studies course, and 3) no more than six hours of credit in the major field is acquired through directed studies courses, excluding Senior Studio and Practicum.

70.494 Directed Study in Studio Art

A special problem in studio art is investigated through conferences and studio work. Prerequisite: permission of instructor. 3 cr.

70.495 Advanced Tutorial in Studio Art

A program of directed studies which afford the advanced students an opportunity to pursue a previously explored problem in greater depth. The purpose is to sharpen and refine skill, content and presentation. Prerequisite: demonstrated proficiency in an area selected for directed studies and permission of instructor. 3 cr.

70.496 Practicum Experience in Studio Art

A program of on-campus and/or off-campus experiences for art majors only. Specific requirements will vary depending upon departmental policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural or artistic area and/or for learning of skills through temporary placement in the field. All Practicum Experiences must be approved by the Art Department, and may be repeated to a maximum of nine credit hours. Practicum Experience may not be substituted for a required course in the major. Prerequisite: permission of Department Chairperson and supervising instructor. 3 or 6 cr.

70.497 Senior Studio

This course is designed to culminate four years of art experience for the BFA studies. The development of personal approach to media and idea is emphasized. Each student will be responsible for developing a self-assigned thematic concern. No assignments will be made by the instructor who will act only as an advisor and coordinator. Course evaluation is by the Senior Studio Review Committee. Enrollment restricted to majors in BFA program. Staff. 3 and 6 cr.

Aesthetics and Critical Studies (Course Prefix: 79)

79.101 Art Concepts

This course introduces the student to the conceptual, technical, and aesthetic aspects of visual form and communication. Literate analysis of the visual elements such as color, line, shape, texture, and value is explored. Emphasis is placed on critical analysis of modes of representation, styles, media, technical procedures, and principles of design. 3 cr.

79-103 801 Art Concepts via the WEB.

Art Concepts is an art appreciation and theory course which will be taught out of one of the University Macintosh labs. It will explore art ideas utilizing the WEB and the electronic library. Study emphasis will focus on understanding concepts rather than the physical making of art. This is not a laboratory course. 3 cr.

79.221 Contemporary Art Concepts

A study of the relationships of contemporary movements in painting, sculpture, architecture, cinema, and multi-media. Emphasis is placed on the analysis of contemporary usage of art movements. 3 cr.

79.225 Photography from Past to Present

A survey of trends and concepts from the camera obscura to the digital image. European as well as American masters will be studied, ranging from the first daguerrotypists and wet-plate itinerants to today's visionaries and post-modern manipulators. Among key figures are Talbot, Fenton, Nadar, Cameron, O'Sullivan, Stieglitz, Atget, Weston, Bravo, Lange, Evans, Callahan, Frank, Arbus, Doisneau, Michals, Mann, and Mapplethorpe. 3 cr.

COLLEGE OF FINE ARTS

Music Department

79.352 Aesthetic Concepts: Critical Issues:

Examination of issues of content, theory, and criticism in contemporary and traditional art and culture. Topics vary.

79.360 Aesthetic Concepts of Graphic Design

Examination of the aesthetic theories and practice of graphic design. Significant practitioners of the art will be highlighted. 3 cr.

79.362 Aesthetic Concepts of Illustration

Examination of the aesthetic theories and practice of illustration. The work of master illustrators will be examined. 3 cr.

79.490 Aesthetics and Critical Studies Seminar

Study of particular aesthetic concepts. Prerequisite: permission of instructor and department. Topics vary. 3 cr.

Directed Studies

Directed study courses are available only to art majors and may be elected provided that 1) the material to be covered is not available in departmental course offerings, 2) instructor is willing to undertake a directed studies course, and 3) no more than six hours of credit in the major field is acquired through Aesthetics and Critical Studies enrollments.

79.494 Directed Study in Aesthetic Concepts

An individual supervised research project relating to questions of aesthetic interpretation and understandings. Prerequisite: permission of instructor and Department. 3 cr.

79.496 Practicum Experience in Aesthetic Concepts

A program of on-campus and/or off-campus experiences for art majors only. Specific requirements will vary depending upon department policies and the nature of the program undertaken by the student. The intent of the practicum experience is to provide an occasion for investigation of a community, social, cultural or artistic area and for applying techniques of problem solving and/or credits. Students will be graded "satisfactory" or "unsatisfactory." Prerequisite: permission of the Department and instructor. 3 cr.

Music Department

Anthony Mele, Chairperson

Professors: Ruth Ashley (Emeritus), Donald Bravo (Emeritus), Alma O. Espinosa, Paul Gay, Paul Gayzagian (Emeritus), Gerald J. Lloyd, Christopher McGahan, David Martins, Anthony Mele, William Moylan, John Ogasapian, Natalo Paella (Emeritus), Kay George Roberts, Rosita Sands, Rawn Spearman (Emeritus), Willis Traphagan, W. Anne Trenkamp, Robert White (Emeritus)

Associate Professors: Dean Bouzianis, Jacqueline Charette, Antone Holevas (Emeritus), Ivan Oak, Scott Fredrickson

Assistant Professor: Paula Telesco

The Music Department offers the Bachelor of Arts degree with a concentration in music and the Bachelor of Music degree with programs in Applied Performance, Music Education, Music Business and Sound Recording Technology.

Music Major (Bachelor of Arts)

Students who wish to pursue the Bachelor of Arts in Music should make formal application to the Department no later than November 15 for the spring semester, or April 15 for the fall semester. In general, applicants from other programs will be expected to have at least a 3.000 in any music courses already taken and at least 2.750 in all courses.

The Bachelor of Arts (B.A.) degree in Music involves the pursuit of musical studies within the context of a liberal arts, rather than a professional curriculum. It is thus the appropriate program for those who wish to gain a solid grounding in music while at the same time keeping their professional options open. The Bachelor of Arts degree may also be elected by students whose interest is in music history, theory, or composition and who are considering graduate study in those areas.

Overview of the Program

The Bachelor of Arts degree with a concentration in music requires the satisfactory completion of a minimum of 120 credits or forty courses, arranged in two main component groups:

I. Thirty to forty-five credits (ten to fifteen courses), in approved music offerings. Fifteen of those credits (five courses) must be in upper-level (numbered 300 and 400) music history and theory offerings. Of the fifteen credits, at least three (at least one course) must be seminar or directed study leading to a completed project, such as a thesis or composition(s);

II. At least seventy-five credits (twenty-five courses) from the offerings of the University outside the field of music, thirty-six of which (twelve courses) must satisfy the University's general education requirement for all degree programs, as described in this catalogue. A student concentrating in music is guided toward the selection of groups of courses, or cognates, that relate to each other and to some aspect, area or era of music in which the student may have developed an interest.

Examples of such cognates might be a group of courses related to the history, language, art, and/or literature of a particular period or country on whose music the student wishes to focus; the philosophy and aesthetics or physical and acoustical properties of a particular theoretical system. In general, considerable latitude may be exercised by students and their faculty advisors in selecting cognate courses and groups.

Course of Study for Music (Bachelor of Arts - Music History)**Freshman Year****Fall Semester**

71.101	Music Theory I	3
71.103	Solfege I	3
72.100	Recital Attendance	0
	Applied Music/Ensemble*	2
42.101	College Writing I	3
	Beh & Soc St (Gen. Ed.)	3
		14

Spring Semester

71.102	Music Theory II	3
71.104	Solfege II	3
72.100	Recital Attendance	0
	Applied Music/Ensemble*	2
42.102	College Writing II	3
	Science, lab (Gen. Ed.)	3-4
		14-15

Sophomore Year**Fall Semester**

71.201	Music Theory III	3
72.100	Recital Attendance	0
	Applied Music/Ensemble*	2
74.261	Music History to 1750	3
	Math (Gen. Ed.)	3
	Science, lab (Gen. Ed.)	3-4
		14-15

Spring Semester

71.202	Music Theory IV	3
72.100	Recital Attendance	0
74.262	Music History after 1750	3
	Ensemble*	(2)
	Literature (Gen. Ed.)	3
	Science (Gen. Ed.)	3
	Values C&C (Gen. Ed.)	3
		15

Junior Year**Fall Semester**

71.	Upper Level Music Theory	3
72.100	Recital Attendance	0
74.	Upper Level Music History	3
76.	Ensemble*	(2)
	3 Cognates	9
		15

Spring Semester

72.100	Recital Attendance	0
74.	Upper Level Music History	3
76.	Ensemble*	(2)
	3 Cognates	9
	Beh & Soc St (Gen. Ed.)	3
		15

Senior Year**Fall Semester**

74.	Upper Level Music Theory	3
74.	Upper Level Music History	3
76.	Ensemble*	(2)
	4 Cognates	12
		18

Spring Semester

74.498	Seminar in Music History	3
76.	Ensemble*	(2)
	4 Cognates	12
		15

Total Credits : 120-123

*These credits cannot be applied to the Bachelor of Arts music degree, but students are encouraged to take two credits of ensemble each semester.

Course of Study for Music (Bachelor of Arts - Music Theory)**Freshman Year****Fall Semester**

71.101	Music Theory I	3
71.103	Solfège I	3
72.100	Recital Attendance	0
	Applied Music/Ensemble*	2
42.101	College Writing I	3
	Beh & Soc St (Gen. Ed.)	3
		14

Spring Semester

71.102	Music Theory II	3
71.104	Solfège II	3
72.100	Recital Attendance	0
	Applied Music/Ensemble*	2
42.102	College Writing II	3
	Science, lab (Gen. Ed.)	3-4
		14-15

Sophomore Year**Fall Semester**

71.201	Music Theory III	3
72.100	Recital Attendance	0
	Applied Music/Ensemble*	2
74.261	Music History to 1750	3
	Math (Gen. Ed.)	3
	Science, lab (Gen. Ed.)	3-4
		14-15

Spring Semester

71.202	Music Theory IV	3
72.100	Recital Attendance	0
74.262	Music History after 1750	3
	Ensemble*	(2)
	Literature (Gen. Ed.)	3
	Science (Gen. Ed.)	3
	Values C&C (Gen. Ed.)	3
		15

Junior Year**Fall Semester**

71.315	Composition I	3
71.402	18th Century Counterpoint	3
72.100	Recital Attendance	0
76.	Ensemble*	(2)
	4 Cognates	12
		18

Spring Semester

71.316	Composition II	3
71.405	Orchestration	3

72.100	Recital Attendance	0
76.	Ensemble*	(2)
	4 Cognates	12
		18

Senior Year**Fall Semester**

71.415	Composition III	3
71.451	Form & Analysis	3
76.	Ensemble*	(2)
	3 Cognates	9
		15

Spring Semester

71.416	Composition IV	3
76.	Ensemble*	(2)
	4 Cognates	12
		15

Total Credits : 123-125

*These credits cannot be applied to the Bachelor of Arts music degree, but students are encouraged to take two credits of ensemble each semester.

Performance (Bachelor of Music)

Students wishing to pursue the specialization in performance may apply to the Chairperson of the Department and are subject to the following requirements:

Application for Performance Specialization

1. Admission is limited to sophomores, juniors or seniors; application is usually made at the end of the first year;
2. application forms are available in the College of Fine Arts Office and must be submitted to the Music Department Chairperson no later than December 1 for fall auditions, May 1 for spring auditions, and August 15 for summer auditions; and
3. written recommendations from the applied instructor and the appropriate applied area head must be submitted to the Chairperson of the Music Department by December 6 for fall, May 6 for spring, and August 21 for summer auditions.

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Admission Requirements

1. A minimum grade of B is required for each ensemble and applied course;
2. a grade point average of 2.000 must be achieved in all music courses;
3. a minimum of thirty music credits are required and must include credit for the following courses:

72.1_1,2 Applied Music
75.131,2 Intro to Keyboard
(non-keyboard majors)
71.100 Fundamentals of
Musicianship
71.101 Theory I
71.103 Solfege I
Ensemble, two semesters; and

4. a successful audition is required, for which repertoire is developed in consultation with the appropriate applied area head.

Retention in Performance
Specialization

1. A minimum grade of B is required for each ensemble and performance specialization course;
2. a grade point average of 2.500 must be maintained for all music courses;
3. continued full-time enrollment in the prescribed curriculum is required;
4. a senior recital is required during the same semester in which the applied music sequence is completed;
5. performance in the College of Fine Arts recital hour is required during each semester of residency.

Course of Study for
Performance Specialization
(Bachelor of Music)

Freshman Year

Fall Semester

71.101	Music Theory I	3
71.103	Solfege I	3
72.100	Recital Attendance	0
72.1_1	Applied Music I	2
75.131	Intro to Keyboard I*	2
76.	Ensemble(s)	2
42.101	College Writing I	3
	Science, lab (Gen. Ed.)	3-4
		16-19

Spring Semester

71.102	Music Theory II	3
71.104	Solfege II	3
72.100	Recital Attendance	0
72.1_2	Applied Music II	2
75.132	Intro to Keyboard II*	2
76.	Ensemble(s)	2
42.102	College Writing II	3
	Math (Gen. Ed.)	3
		16-18

Sophomore Year

Fall Semester

71.201	Music Theory III	3
71.203	Solfege III	3
72.100	Recital Attendance	0
72.2_1	Performance Applied I	3
74.261	Music History to 1750	3
75.233	Conducting I	2
75.	Performance Elective	3
76.	Ensemble(s)	2
		19

Spring Semester

71.202	Music Theory IV	3
71.204	Solfege IV	3
72.100	Recital Attendance	0
72.2_2	Performance Applied II	3
74.262	Music History after 1750	3
75.234	Conducting II	1
75.235	Conducting II Lab	1
75.	Performance Elective	3
76.	Ensemble(s)	2
		19

Junior Year

Fall Semester

72.100	Recital Attendance	0
72.3_1	Performance Applied III	3
75.493	Performance Seminar I	3
7.	Upper Level Music Elect	3
76.	Ensemble(s)	2
76.	Chamber Ensemble	1
	Beh & Soc St (Gen. Ed.)	3
	Language Studies**	(3)
		15-16

Spring Semester

72.100	Recital Attendance	0
72.3_2	Performance Applied IV	3
75.494	Performance Seminar II	3
76.	Ensemble(s)	2
76.	Chamber Ensemble	1
	Upper Level Music Elective	3
	Science, lab (Gen. Ed.)	3-4
	Language Studies**	(3)
		15-16

Senior Year

Fall Semester

72.100	Recital Attendance	0
72.4_1	Performance Applied V	3
76.	Ensemble(s)	2
76.	Chamber Ensemble	1
	Upper Level Music Elective	3
	Literature (Gen. Ed.)	3
	Beh & Soc St (Gen. Ed.)	3
		15

Spring Semester

72.100	Recital Attendance	0
72.4_2	Perform. Applied VI	3
72.499	Senior Recital	1
76.	Ensemble(s)	2
76.	Chamber Ensemble	1
	Science (Gen. Ed.)	3
	Values C & C (G. Ed.)	3
		13

Total Credits 128-134

*75.131, 75.132 Intro to Keyboard I & II, non-keyboard majors only

**Voice Performance majors are required to enroll in two consecutive semesters of foreign language

Performance: Emphasis in
Sound Recording Technology

Though prospective Sound Recording Technology students enroll in certain specific courses for their specialization in the freshman year, retention in the program requires an application to the Program Coordinator prior to the sophomore year.

Admission Requirements

1. Grade point average of 2.500 or higher in first-year music courses;
2. a successful audition in the student's major performance medium; and
3. demonstrated readiness to undertake the appropriate calculus sequence (satisfactory completion of 92.121 Precalculus Mathematics and 92.115 College Trigonometry courses or passing grades on the corresponding mathematics department qualifying examinations or passing grades on the appropriate CLEP Tests).

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General Requirements for Retention and Graduation

1. Sophomore Year Retention
 - a. completion of the Music 71.103, 71.104, & 71.203;
 - b. a minimum of 2.500 GPA in sound recording, mathematics, and physics coursework; and
 - c. successful completion of Applied IV.
2. Junior Year Retention
 - a. 3.000 GPA in all sound recording technology coursework; and
 - b. 2.500 GPA in electrical engineering, physics, and mathematics course work.
3. Graduation Requirements
 - a. 2.500 cumulative GPA;
 - b. 3.000 GPA in all sound recording technology and support courses; and
 - c. completion of approved senior tape project.

**Course of Study for
Performance: Sound
Recording Technology
Emphasis (Bachelor of Music)**
Freshman Year**Fall Semester**

71.101	Music Theory	3
71.103	Solfege I	3
72.100	Recital Attendance	0
72.1_1	Applied Music I	2
75.131	Intro to Keyboard I*	2
76.	Ensemble(s)	2
42.101	College Writing I	3
92.124	Precalculus for Sci & Eng.(Math/Gen. Ed.)	3
		18

Spring Semester

71.101	Music Theory II	3
71.104	Solfege II	3
72.100	Recital Attendance	0
72.1_2	Applied Music II	2
76.	Ensemble(s)	2
42.102	College Writing II	3
92.115	College Trigonometry	3
		16

Sophomore Year**Fall Semester**

71.201	Music Theory III	3
71.203	Solfege III	3
72.100	Recital Attendance	0
72.2_1	Applied Music III	2
74.261	Music History to 1750	3
76.	Ensemble(s)	2
92.131	Calculus I	4
		17

Spring Semester

71.202	Music Theory IV	3
72.100	Recital Attendance	0
72.2_2	Applied Music IV	2
74.262	Music History after 1750	3
76.	Ensemble(s)	2
78.310	Intro to Recording	3
92.132	Calculus II	4
95.101	Intro to Physics & Lab (Science, Lab/Gen. Ed.)	4
		21

Junior Year**Fall Semester**

71.306	Aural Percept. of Timbre & Space	3
71.390	Acoustics & Psychoacoustics	3
72.100	Recital Attendance	0
72.3_1	Applied Music V	2
75.334	Conducting for SRT	3
76.	Ensemble(s)	2
78.410	Rec. Technology I Rec. Technology I Lab	3 0
		16

Spring Semester

72.100	Recital Attendance	0
72.3_2	Applied Music VI	2
76.	Ensemble(s)	2
78.350	Video Production	3
78.411	Rec. Technology II Rec. Technology II Lab Upper Level Music Elective	3 0 3
16.211	Fund. of Electricity & Electronics & Lab (Science, lab/Gen. Ed.)	4
		17

Senior Year**Fall Semester**

72.100	Recital Attendance	0
76.	Ensemble(s)	2
78.450	The Recording Industry	3

78.470	Recording Studio Repair & Maintenance	3
	Upper Level Music Elective	3
49.201	Economics I (Beh & Soc St/Gen. Ed.)	3
91.101	Computing I & Lab (Science/Gen. Ed.)	4
		18

Spring Semester

78.493	Internship or	
78.494	Senior Project Literature (Gen. Ed.)	6 3
	Beh & Soc St (Gen. Ed.)	3
	Values, C & C (Gen. Ed.)	3
		15

Total Credits: 138

*75.131 Intro to Keyboard I, non-key-board majors only

**Sound Recording Technology
Internship Policies**

Internships in Sound Recording Technology are governed by the following policies. Specific written authorization of the Coordinator of Sound Recording Technology, given prior to the internship experience, is required for any deviations in these policies.

1. The internship may only be undertaken after the student has successfully completed the courses: 78.410 Recording Technology I and 78.411 Recording Technology II;
2. the student must have a cumulative grade point average of 2.500 or higher and a GPA of 3.000 in Sound Recording Technology and support courses prior to undertaking the internship, to insure that students are academically prepared for the study;
3. the internship shall be for a period of fifteen weeks. A minimum of fifteen to twenty hours per week is to be spent at the location of the internship sponsor, working as assigned. It is expected that twenty hours per week will be the norm; additional hours are strongly encouraged, but not required;
4. the student is registered under course 78.493 Internship in Sound Recording Technology for six credit hours. The intern must be registered as a full-time student during the semester of the

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internship. If necessary, the student will register for one or two sections of "Directed Studies in SRT" to reach the credit load of a full-time student;

5. the student/intern shall receive no compensation and shall be considered a full-time student undertaking studies with the intern sponsor. The sponsor shall not be held responsible for Workman's Compensation, Disability Insurance, Unemployment Insurance, and other legal obligations normally assumed for regular employees. The intern shall provide his or her own accident and health insurance;
6. where circumstances are appropriate, the internship sponsor may arrange to reimburse the intern for housing, board, travel, and incidental expenses; and
7. the student will solicit the internship, and interview with the internship sponsor prior to the beginning of the internship experience. In the event that the SRT program is solicited by an prospective internship sponsor and a student is recommended by the Coordinator of Sound Recording Technology, it remains the student's responsibility to interview and otherwise arrange for the internship.

Performance: Emphasis in Music Business

As an alternative to the traditional music degree program, the Bachelor of Music Degree in Performance: Emphasis in Music Business combines a traditional music curriculum with courses and experiences related to the Music Industry. The program focuses on music business, management, marketing, sales, publishing, retailing, promotion, record and concert promotion and management, and prepares graduates knowledgeable in all aspects of the Music Industry.

Though prospective Music Business students enroll in certain specific courses for their specialization in the freshman year, retention in the program requires an application to the Program Coordinator prior to the sophomore year.

Internship

The Internship experience is an important bridge between academic preparation and career development. The student must have completed all required courses and is expected to have acquired the necessary knowledge to be successful in the Music Business Industry. Students undertake an Internship at a professional firm involved in some facet of the Music Industry.

Additional Information

Additional regulations and policies regarding the Internship are available in the Music Business Student Handbook distributed to each student enrolled in the Bachelor of Music in Performance: Emphasis in Music Business Program.

General Requirements for Retention and Graduation

Minimum grade point requirements must be maintained in order to continue as a Music Business major. At the conclusion of each semester students will input their courses and grade information into the computerized Declaration of Intent to Graduate Form and present the disk and a printed copy along with a transcript to their advisor. Grade point averages and completed course information will be used to select appropriate future courses. The Declaration of Intent to Graduate Form Program will automatically calculate the grade point average for the three areas of concern: Music Courses, Music Business Courses and total Grade Point Average. The minimum grade point requirements are as follows:

Music Courses	2.500
Music Business Courses	3.000
Cumulative Grade Point Avg.	2.500

If any of these standards are not met, the student will be suspended from the program and will not be allowed to enroll in courses within the major. Student will repeat any Music Business course in which they received a grade of D or below and, upon receiving a minimum grade of CD or better, will be readmitted to the program.

Course of Study for Performance: Music Business Emphasis (Bachelor of Music)

Freshman Year

Fall Semester

71.101	Music Theory I	3
71.103	Solfege I	3
72.100	Recital Attendance	0
72.1_1	Applied Music I	2
76.	Ensemble(s)	2
77.101	Music Business I	3
42.101	College Writing I	3
	Science, lab (Gen. Ed.)	3-4
		19-20

Spring Semester

71.102	Music Theory II	3
71.104	Solfege II	3
72.100	Recital Attendance	0
72.1_2	Applied Music II	2
76.	Ensemble(s)	2
77.102	Music Business II	3
77.201	Computers in Music Bus.	3
42.102	College Writing II	3
		19

Sophomore Year

Fall Semester

71.201	Music Theory III	3
71.203	Solfege III	3
72.100	Recital Attendance	0
72.2_1	Applied Music III	2
75.131	Intro. to Keyboard. I*	2
75.233	Conducting I	2
76.	Ensemble(s)	2
60.201	Accounting/Financial Literature (Gen. Ed.)	3
		20

Spring Semester

71.202	Music Theory IV	3
71.204	Solfege IV	3
72.100	Recital Attendance	0
72.2_2	Applied Music IV	2
75.234	Conducting II	1
75.235	Conducting II Lab	1
76.	Ensemble(s)	2
60.202	Accounting/Managerial	3
92.183	Statistics (Math/Gen. Ed.)	3
		18

Junior Year**Fall Semester**

72.100	Recital Attendance	0
72.3_1	Applied Music V	2
74.261	Music History to 1750	3
76.	Ensemble(s)	2
65.301	Bus Soc & Pub Policy (Values C&C/Gen. Ed.)	3
49.201	Economics I (Beh Soc St/Gen. Ed.)	3
77.304	Promotion & Merchandising	3
78.305	Survey of Music Technology	3
		19

Spring Semester

72.100	Recital Attendance	0
72.3_2	Applied Music VI	2
74.262	Music History after 1750	3
76.	Ensemble(s)	2
77.303	Publishing & Copyright	3
49.202	Economics II	3
41.261	Legal Concepts (Beh & Soc St/Gen. Ed.)	3
	Science, Lab (Gen. Ed.)	3-4
		19-20

Senior Year**Fall Semester**

72.100	Recital Attendance	0
72.4_1	Applied Music VII	2
76.	Ensemble(s)	2
77.401	Music Bus. Seminar	3
77.404	Music Bus Entrepr Upper Lev. Mus. Elect.	3
	Science (Gen. Ed.)	3
		16

Spring Semester

77.402	Music Business Internship	6
		6

Total Credits: 136-138

*75.131 Intro to Keyboard I for non-keyboard majors only

Music Education**Admission Requirements**

1. Though prospective Music Education students may take some elective courses for their specialization in the freshman and sophomore years, admission to the program of professional studies requires formal application to the Coordinator of Music Education prior to the junior year but no later

than upon completion of 60 credit hours;

2. prospective music education students must pass courses in music including Music Theory, Solfege, Conducting, Music History, Applied Music, and Ensembles;
3. prospective music education students must pass two semesters of College Writing with a grade of 'C' or better; and
4. prospective music education students must achieve a cumulative average of 2.750 or better overall and achieve the same cumulative average in the aggregate of music courses.

Retention Requirements

Students must maintain a minimum of 2.750 cumulative average in all coursework attempted.

Music Education Apprentice Teaching Policies

1. Decisions regarding school placement for apprentice teachers are made cooperatively involving music education faculty, the Coordinator of Music Education, and the cooperating school personnel. Under no circumstances will students be permitted to do their apprentice teaching for schools that have not received final approval by the Coordinator of Music Education and faculty.
2. Apprentice teachers seeking certification in K-9 are required to have teaching responsibilities in primary, intermediate, and middle school (or junior high) classrooms.
3. Candidates seeking certification in grades 5-12 are required to have teaching responsibilities in middle school (or junior high) and senior high classrooms.
4. Candidates seeking certification in K-12 are required to have teaching responsibilities in primary, intermediate, middle school (or junior high), and high school classrooms.
5. The teaching apprentice's teaching assignment will normally include solo teaching, team teaching, assisting cooperating teachers and observing both

music and non-music teachers.

6. The apprentice's teaching load will include adequate time for conferences with the cooperating practitioner(s).
7. The teaching apprentice assignment typically includes four to six teaching assignments per day with the total weekly assignments not to exceed twenty-five.
8. In most cases, apprentices should expect to remain after school for meetings and/or conferences on at least two days per week.
9. All apprentice teachers are visited on site by University music education faculty a minimum of three times during the semester. Visitations may be either scheduled or non-scheduled.
10. State Certification regulations require the apprentice teacher, cooperating teacher(s), and University supervising faculty to meet jointly to complete pre-practicum reports.
11. University supervisors and cooperating teachers provide written evaluation of the apprentice teacher following observations, in consultation with the apprentice teacher. Evaluations are made available to the apprentice teacher, the cooperating teacher(s), and the supervising University music education faculty.
12. A student who is enrolled in an Apprentice Teaching course is permitted to withdraw only for documented medical reasons, personal emergency, or upon the advice and approval of the Coordinator and Music Education faculty. In those special cases, students will be permitted upon approval of the Coordinator of Music Education and Chairperson, Performance Department, to register and complete the Apprentice Teaching course the next consecutive semester.
13. A student may be withdrawn from apprentice teaching at any time with a grade of U when his/her performance in teaching is unsatisfactory; when the person has demonstrated a record of irresponsibility in carrying out teaching assignments; when absent for more than two days without satisfactory documented reason; or when determined to be engaging in activity, including employment, which inter-

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fere with the performance of assigned responsibilities and violate the terms of the apprenticeship as originally agreed upon by the University music education faculty and cooperating teacher(s) and/or school system.

14. Under no circumstances may the apprentice teacher be "employed" by a school and/or receive compensation in that capacity while registered for and completing the Apprentice Teaching semester without the express permission of the Coordinator and the music education faculty.
15. A student who receives a grade of U or is withdrawn with a grade of U from a course in Apprentice Teaching is terminated as a candidate for the degree Bachelor of Music in Music Education.
16. Student teachers are required to keep a detailed log, (daily record), of all practicum hours completed during the semester. The log must indicate grade levels (elementary, middle school/jr. high, and/or high school, as appropriate) and type of activity engaged in (observing, assisting, or taking full responsibility) for all hours. The accuracy of logs and appropriateness of hours will be verified by the signatures of the cooperating teachers at monthly intervals throughout the semester-long practicum and the signature of the Director of Music at the end of the Practicum, once all hours have been completed.
17. The student teacher is responsible for monitoring the progress made toward accumulation of hours in each category mandated by the State. State regulations now require that at least 150 hours must be of "direct instructional responsibilities" during the practicum for each level of certification, N-9 and/or 5-12. If a student teacher is completing a N-12 practicum, at least 300 hours of the minimum 350 to be completed must be at the level of "direct instructional responsibilities." Direct instructional responsibilities are to be interpreted to mean observing instruction, assisting in instruction, and actual instruction. Other hours completed during the practicum may be in areas indirectly related to instruction, such as staff

meetings, parent/teacher conferences, in-service workshops, educational conferences, and other types of education or instruction-related activities, to be approved by cooperating teachers.

18. The student teacher is responsible for monitoring the progress made toward accumulation of hours at each level of music instruction, as appropriate to the type of certificate being sought (N-9, 5-12, or both) — elementary school, middle-school/junior high, and/or high school hours. While UMass Lowell requires that student teachers have some experience at all levels of music instruction available in the community, (appropriate to the type of certificate being sought), the largest total of hours should be spent at the individual student's primary level of emphasis.
19. All school-related activities participated in by the student teacher at the school site during the normal school day are to be counted toward practicum hours. Instruction-related activities that occur at other times may also count toward the accumulation of practice hours, with the approval of the cooperating practitioner. Such activities might include, but are not limited to: set-up or organization of classrooms prior to the start of the school year, bandcamps or orientation/audition sessions prior to start of school year; private lessons, tutoring, sectionals, or rehearsals that occur before or after school; staff meetings, conferences, in-service workshops, and other activities approved by the cooperating practitioners.
20. Any off-site hours, earned through some type of special experience (e.g., school trips, outside educational conference) must be verified in writing and approved by the appropriate Cooperating Practitioner in the community. These hours must be submitted in an addendum to the log that describes in detail, the relevant activities and experiences, and lists the number of hours to be counted from these experiences. The signature of the appropriate Cooperating practitioner will be used as verification that these hours are reasonable and appropriate to the student teacher practicum experience. No hours of this nature will be allowed to count

without submission of this signed addendum, as described above, to the Coordinator of Music Education on the date that the final log is due.

Application for Professional Certification

Upon completion of the degree program Bachelor of Music in Music Education, graduating students may file an application for professional certification to teach in Massachusetts. When the application materials are complete, the College of Fine Arts recommends the graduate for a teaching certificate. The recommendation, forwarded through the Office of the Dean, College of Education, is made to the Massachusetts Department of Teacher Certification which has sole legal responsibility for granting certification.

Course of Study for Music Education (Bachelor of Music)

Freshman Year

Fall Semester

71.101	Music Theory I	3
71.103	Solfège I	3
72.100	Recital Attendance	0
72.1_1	Applied Music I	2
75.131	Intro to Keyboard*	2
76.	Ensemble(s)	2
42.101	College Writing I	3
92.111	Math Perspectives (Math/Gen. Ed.)	3
		18

Spring Semester

71.102	Music Theory II	3
71.104	Solfège II	3
72.100	Recital Attendance	0
72.1_2	Applied Music II	2
73.151	Intro to Music Ed.	2
75.132	Intro to Keyboard II*	2
76.	Ensemble(s)	2
42.102	College Writing II	3
73.243	Introduction to Voice#	2

17-19

Sophomore Year

Fall Semester

71.201	Music Theory III	3
71.203	Solfège III	3
72.100	Recital Attendance	0
72.2_1	Applied Music III	2

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74.261	Music History to 1750	3
75.233	Conducting I	2
76.	Ensemble(s)	2
47.260	Human Development I (Beh & Soc St/Gen. Ed.)	3
	Science (Gen Ed.)	3
		21

Spring Semester

71.202	Music Theory IV	3
71.204	Solfège IV	3
72.100	Recital Attendance	0
72.2_2	Applied Music IV	2
73.201	Computers in Mus. Ed.	3
74.262	Music History after 1750	3
75.234	Conducting II	1
75.235	Conducting II Lab	1
76.	Ensemble(s)	2
		18

Junior Year**Fall Semester**

72.100	Recital Attendance	0
72.3_1	Applied Music V	2
73.242	Intro to Strings	2
73.370	Hist Phil Princ Prac	4
76.	Ensemble(s)	2
	Science, lab (Gen. Ed.)	3-4
	Beh Soc St (Gen. Ed.)	3
		16-17

Spring Semester

72.100	Recital Attendance	0
72.3_2	Applied Music VI	2
73.144	Intro to Woodwinds	2
73.162	Intro to Percussion	2
73.392	Contemp. Methods	3
76.	Ensemble(s)	2
	Literature (Gen. Ed.)	3
	Science, lab (Gen. Ed.)	3-4
		17-18

Senior Year**Fall Semester**

72.100	Recital Attendance	0
72..4_1	Applied Music	2
73.141	Intro to Brass	2
73.392	Gen. Mus. Methods	4
75.463	Vocal Pedagogy** or	3
73.393	Inst.Cho Rep/Reh Tech##	3
76.	Ensemble(s)	2
	Upper Level Music Elective	3
	Values C&C (Gen. Ed.)	3
		19

Spring Semester

72.4-2	Applied Music	2
73.491	Practicum K-9 or	6
73.492	Practicum 5-12 or	6
73.495	Practicum K-12	10
		8-12

Total Credits: 134-142

*waived for keyboard applied students

#waived for vocal applied students

**required for vocal applied students

##required for instrumental applied students; keyboard applied students may substitute vocal pedagogy

Instrumental and Vocal Methods Requirements

Instrumental applied students complete one semester of each instrumental class plus "Introduction to Voice." These students may elect to waive the instrumental class in their applied area of study, with permission of the Coordinator of Music Education.

Vocal applied students complete one semester of each instrumental class plus "Vocal Pedagogy."

Keyboard applied students may substitute "Vocal Pedagogy" for "Instrumental Repertoire and Rehearsal Techniques" and may use one of these courses to fulfill the upper level elective requirement.

**Music Theory
(Course Prefix: 71)****71.100 Fundamentals of Musicianship**

A study of the visual and aural symbolics of music and their application to the comprehension of the architectural, organizational, and aural elements of music literature. Music majors only. 3 cr.

71.101 Music Theory I

An intensive study of the theoretical language of music. Stresses part writing in S.A.T.B. and basso continuo realization with a free instrumental part which utilizes free voice leading relative to the use of non-harmonic activity and the harmonic principles through first and second inversion triads. Instruments of the string section are covered, and appropriate listening assignments are given. Original composition in the style being studied is required. 3 cr.

71.102 Music Theory II

A continuation of the practices of Music Theory I relative to part writing both vocal and instrumental including secondary triads, the Neapolitan sixth, modal interchange, dominant sevenths in inversion and root position, modulation, and secondary dominants. Instrumentation covers the woodwind section, and original composition in the style being covered is required. Prerequisite: 71.101. 3 cr.

71.103 Solfège I

An introduction to the techniques of translating the symbolics of music into audible sounds and the reverse. It employs a fixed "do" system and deals with diatonic melodies in major and minor keys, intervals, fundamental beat-patterns, meter and rhythm. Literature from a variety of sources is employed, and harmonic dictation follows the sequence and progress of Music Theory I. 3 cr.

71.104 Solfège II

A continuation of Visual and Aural Perception of Music I requiring greater facility in the skills of perception and execution developed in the previous semester and the mastery of additional skills required to deal intellectually with notational and musical problems encountered in more sophisticated literature. A variety of clefs, beat subdivisions, artificial divisions, modal and modulating music, jazz and blues idioms as well as an introduction to non-diatonic music literature are included in the course. Harmonic dictation throughout the semester is correlated to Music Theory II. Prerequisite: 71.103. 3 cr.

71.110 Basic Music Theory

A study of the symbolics of music and their application to the comprehension of the architectural, organizational and aural elements of music literature. Non-music majors only. 3 cr.

71.201 Music Theory III

A continuation of the practices of Music Theory II relative to part writing both vocal and instrumental including remote modulation and satellite keys, the diminished seventh, augmented sixth, ninth, eleventh, and thirteenth extensions, sequential secondary dominants and secondary sevenths. Instrumentation covers the brass section; original work in the style being covered and in various formal configurations is required. Prerequisite: 71.102. 3 cr.

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71.202 Music Theory IV (20th Century)

A study of twentieth century music theory via a compositional approach relative to tertial, quartal, and secundal vertical sonorities, and linear combinations featuring modal and synthetic scale resources as well as serial and preserial atonality. Prerequisite: 71.201. 3 cr.

71.203 Solfege III

An intensive application of requisite skills to chromatic and non-diatonic music, changing and composite meters, displaced accents, cross rhythms, and a vertical approach to reading often necessary in the study of scores. Advanced tonal as well as tonal literature is considered. Harmonic dictation continues to follow the sequence and progress of Music Theory III. Prerequisite: 71.104. 3 cr.

71.204 Solfege IV

A concentration on the techniques employed in solving the notation and musical problems of the music of the 20th century. The considerations include synthetic and non-Western scales, pitch sets and twelve-tone serialism. Prerequisites: 71.203, 71.215, 71.216. 3 cr.

71.306 Aural Perception of Timbre and Space

The recognition and identification of timbral modifications and spatial characteristics. Aural analysis of historically significant and current music recordings for recording techniques, musical balance, performance intensity, sound quality, and imaging. Development of critical listening skills and sound evaluation techniques. 3 cr.

71.315 Composition I

An application of various techniques of musical composition. Class compositions will be performed and critiqued. Prerequisites: 71.201, 71.402, 71.405. 3 cr.

71.316 Composition II

Individual composition work. By permission of Chair of Department.

Prerequisite: 71.315. 3 cr.

71.336 Vocal Arranging

Analysis and practical application of techniques of vocal scoring including women's voices, men's voices, and mixed voices in varied configurations and styles. Prerequisite: 71.201. 3 cr.

71.390 Physical Acoustics and Psychoacoustics

The physical attributes of sound and acoustic measurement; displacement, time, velocity, acceleration, force, energy, resonance, wave shapes and spectral energy distribution are examined for most instruments; acoustic properties of the ear and of enclosed environments; acoustic measurements and instruments. The interrelationships and differences of physical acoustics and psychoacoustics are stressed. 3 cr.

71.402 Eighteenth Century Counterpoint

An exposition of the contrapuntal practice of the period, as exemplified by the works of J. S. Bach. Specifically, the course deals with the technique of developing independent but complementary melodic lines through the ornamentation of a basic harmonic structure. Representative vocal and instrumental forms are heard and analyzed and the original idiomatic writing is required. Prerequisite: 71.201. 3 cr.

71.405 Orchestration

A study of orchestral writing for the standard symphony orchestra. Emphasis is on advanced instrumentation and on individual scoring projects. Prerequisite: 71.201. 3 cr.

71.407 Electronic Music

A study of the most recent experiments and techniques in electronic music; composition and performance using such equipment as the synthesizer and computers. 3 cr.

71.413 Seminar in Music Theory

An intense study of advanced topics in music theory. Prerequisites: 71.402, 71.405, 71.451. 3 cr.

71.415 Composition IV

Limited to undergraduate majors in composition. Involves individual composition, composition under the direction of faculty. Prerequisite: 71.315. Permission of chairperson required. 3 cr.

71.416 Composition III

Continuation of 71.415. Prerequisite: 71.415. Permission of chairperson required. 3 cr.

71.450 Pedagogy of Theory

An examination of the principal points of view relative to tonal theory as expressed

by the major theorists of the 20th century. Relative weaknesses and strengths will be examined, and students will be expected to develop their own presentation of specific topics for particular pedagogical situations. Prerequisite: 71.201. 3 cr.

71.451 Form and Analysis

A study of the structure and organizational principles of music. Prerequisite: 71.202. 3 cr.

71.495 Directed Study in Music Theory

Individual work under the supervision of a member of the music theory faculty on a wide variety of topics approved by the instructor and the theory faculty. Permission of chairperson required. 3 cr.

71.498 Seminar in Music Theory

An intense study of advanced topics in music theory. Prerequisite: 71.402, 71.405, 71.451. 3 cr.

Applied Music (Course Prefix: 72)**72.101-402 Applied Keyboard I-VIII**

Studio instruction in graduated sequence with keyboard as the principal instrument. 2 cr.

72.111-412 Applied Voice I-VIII

Studio instruction in graduated sequence with voice as the principal instrument. 2 cr.

72.121-422 Applied Woodwinds I-VIII

Studio instruction in graduated sequence with woodwind as the principal instrument. 2 cr.

72.131-432 Applied Brass and Percussion I-VIII

Studio instruction in graduated sequence with brass or percussion as the principal instrument. 2 cr.

72.141-442 Applied Strings I-VIII

Studio instruction in graduated sequence with string as the principal instrument. 2 cr.

72.251-452 Performance Keyboard I-VI

Studio instruction in graduated sequence with keyboard as the principal instrument for performance majors. 3 cr.

72.261-462 Performance Voice I-VI

Studio instruction in graduated sequence with voice as the principal instrument for performance majors. 3 cr.

72.271-472 Performance Woodwinds I-VI

Studio instruction in graduated sequence with woodwind as the principal instrument for performance majors. 3 cr.

72.281-482 Performance Brass and Percussion I-VI

Studio instruction in graduated sequence with brass or percussion as the principal instrument for performance majors. 3 cr.

72.291-492 Performance Strings I-VI

Studio instruction in graduated sequence with string as the principal instrument for performance majors. 3 cr.

72.499 Senior Recital

Public performance to be presented, registered concurrently with Applied Music VIII or Performance Applied Music VI. 1 cr.

Music Education (Course Prefix: 73)**73.141 Introduction to Brass**

Intensive class instruction toward the development of basic performance proficiency on brass instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes. 2 cr.

73.144 Introduction to Woodwinds

Intensive class instruction toward the development of basic performance proficiency on woodwind instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes. 2 cr.

73.151 Introduction to Music Education

Designed to provide the student with an overview of the principles and practices of music education in today's public schools. Students will observe regular classrooms and music instruction at all levels of N-12 education. This course is a prerequisite for all professional education courses in music education and includes the component of required pre-practicum fieldwork. 2 cr.

73.162 Introduction to Percussion

Intensive class toward the development of basic performance proficiency on percussion instruments and the development of pedagogical skills techniques for beginning instruction and demonstration purposes. 2 cr.

73.201 Computers in Music Education

An introduction into the use of Macintosh, DOS, and other computer systems and software applications used within the Music Industry and Music Education. Topics will include programs, input devices, disk drives, I/O ports, peripherals, communication networks, operating systems, computer composition, MIDI, sound cards, interactive multi-media, and the use of such applications as: word processors, spreadsheets, data bases, desktop publishing, and music notation, fundamentals, ear training, theory, composition, and arranging. 3 cr.

73.201 Computers in Music Education

Introduction to the role of computers and technology, including use of MIDI and other educational tools in music education programs. Course stresses the development of basic computer literacy, including knowledge of word processing, database, and spreadsheet applications as essential tools for educators. 3 cr.

73.242 Introduction to Strings

Intensive class instruction toward the development of basic performance proficiency on string instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes. 2 cr.

73.243 Introduction to Voice

Intended to cultivate the fundamental principles of singing. The psychology of singing and physiology of the singing voice are considered as they apply to tone production and resonance. This course is designed for non-voice majors. 2 cr.

73.370 Historical and Philosophical Principles and Practices in Music Education

Comprehensive survey of the historical, philosophical, sociological, psychological and political factors that affect American schools, particularly as they impact upon current principles and practices in the discipline of music education. As one of the core professional music education courses, the course includes the component of pre-practicum fieldwork in the form of observations and interviews. cr.

73.392 General Music Methods

A course designed to present the basic fundamentals of music pedagogy, including lesson planning and the writing of instructional objectives, with a focus on general music instruction at all levels. The course discusses basic principles of curriculum and instruction, assessment issues, national and state standards/curriculum frameworks, and learning styles and development stages as related to instructional modes and strategies. As one of the core professional music education courses, the course includes the component of pre-practicum fieldwork in the form of observations, assisting experiences, and actual teaching in school settings. 4 cr.

73.393 Instrumental Repertoire and Rehearsal Techniques

Examination of appropriate instrumental repertoire for the secondary school level and effective instrumental rehearsal techniques. Includes study of rehearsal planning, score preparation, and the development of fundamental musicianship skills necessary for a successful instrumental ensemble. 3 cr.

73.397 Contemporary Methodologies

Investigation of some of the most popular methods of teaching music, including Kodaly, Orff, Dalcroze, and comprehensive musicianship. Discussion of contemporary issues including music in special education and multicultural music education. As one of the core professional music education courses, includes the component of fieldwork in selected settings. 3 cr.

73.491 Apprentice Teaching of Music (K-9)

Full-time apprentice teaching of music in public elementary and middle schools under the supervision of qualified classroom teachers, administrators, music specialists, and members of the college faculty. Provides practical experience for the student in applying contemporary principles and techniques studied in music and music education courses. For students seeking certification at K-9 level only. Prerequisite: 73.392. 6 cr.

73.492 Apprentice Teaching of Music (5-12)

Full-time apprentice teaching in public secondary schools under the supervision of qualified music specialists, administrators, and members of the college faculty. Provides practical experience for the stu-

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dent in applying contemporary principles and techniques studied in music education courses. For students seeking certification at 5-12 level only. Prerequisite 73.392. 6 cr.

73.495 Apprentice Teaching of Music (K-9, 5-12)

Full-time apprentice teaching in public elementary schools under the supervision of qualified music specialists, administrators, and members of the college faculty. Provides practical experience for the student in applying contemporary principles and techniques studied in music education courses. For students seeking certification at both K-9 and 5-12 levels. Prerequisite: 73.392. 10 cr.

73.496 Directed Study in Music Education

Individual work under the supervision of a member of the music education faculty on a specific topic approved by the instructor and the music education faculty. Permission of Coordinator of Music Education required. 3 cr.

**Music History
(Course Prefix: 74)****74.161 Music of Western Civilization**

A survey of music from earliest times to the present. Significant forms, styles, composers and aesthetic concepts are examined. Open to non-music majors only. 3 cr.

74.261 Music History to 1750

A study of sacred and secular musical forms from pre-Christianity to 1750. 3 cr.

74.262 Music History after 1750

A study of musical forms and styles from 1750 to present. 3 cr.

74.301 American Music

A historical survey of music in the United States from colonial times to the present. Open to music and non-music majors. 3 cr.

74.354 Women in Music

Survey of the role of women in music from ancient times to the present, with primary emphasis on composers of art music in the western tradition. Open to music and non-music majors. 3 cr.

74.355 Jazz

An intense study of the history of jazz from its origins to the present, covering a wide selection of styles and schools of jazz in various ensemble configurations. Open to music and non-music majors. 3 cr.

74.356 American Musical Theatre

A study of the American stage musical and its development from the late eighteenth century. The course concentrates on Broadway musicals from the 1920s to the present. 3 cr.

74.368 The American Popular Song

A study of American popular song from 1920 to the present. Emphasis will be placed on such representative composers as Kern, Berlin, Gershwin, Rodgers, Porter, Arlen and such lyricists as Hart, Strayhorn, Dietz and Hammerstein. Examples of songs performed by instrumentalists as well as vocalists will be illustrated by recordings and live performances whenever possible. 3 cr.

74.369 Topics in Jazz

A study of jazz in a seminar format will be offered in a revolving basis and will emphasize the big band, bop, free jazz and fusion styles. 3 cr.

74.386 Rock & Roll

Rock & Roll will trace the roots of American popular music from its origins and influences from the earliest European song forms to American folk songs, gospel, country, rhythm and blues, jazz, and other popular forms up through current trends as related to the development of the music industry and other socio-musical influences of the commercial song from the 1500s to the present. 3 cr.

74.451 History of Choral Music

A study of the stylistic and compositional approaches to choral music from Ockegham to Stravinsky. Prerequisite: 74.261, 74.262. 3 cr.

74.452 History of Opera

A study of the stylistic and compositional approaches to opera. Prerequisite: 74.261, 74.262. 3 cr.

74.454 Symphony

A study of the stylistic and compositional approaches to symphony. Prerequisite: 74.261, 74.262. 3 cr.

74.459 Performance Practice

Functions as a seminar exploring performance practices of western art music from the middle ages to the present. 3 cr.

74.461 Music of the Middle Ages

The theory, notations, forms and styles of music from patristic times to 1400 are examined in depth. Prerequisite: 74.261. 3 cr.

74.462 Music of the Renaissance

A study of mass, motet, chanson, madrigal and instrumental music of the fifteenth and sixteenth centuries. Prerequisite: 74.261. 3 cr.

74.463 Music of the Baroque Era

A stylistic study of the music of the period from 1600-1750. Prerequisite: 74.262. 3 cr.

74.464 Music of the Classic Era

A study of the solo, chamber, symphonic and operatic literature from 1720-1827. Prerequisite: 74.262. 3 cr.

74.465 Music of the Romantic Era

A study of instrumental and vocal forms and styles from 1820 to 1900. Prerequisite: 74.262. 3 cr.

74.466 Music of the Early Twentieth Century

An examination of the stylistic trends of music from late Romanticism to mid-century. Emphasis is on listening and analysis, as well as musicological commentary. Prerequisite: 74.262. 3 cr.

74.467 Music of the Late Twentieth Century

Stylistic trends from mid-century to the present. Emphasis on listening and analysis. Prerequisite: 74.262. 3 cr.

74.495 Directed Study in Music History

Individual work under the supervision of a member of the music history faculty. May be repeated with permission of the chairperson. 3 cr.

74.498 Seminar in Music History

An intense study of advanced topics in music history. Prerequisites: 74.261, 74.262, at least four 74-prefix courses at the 300-level or above, and permission of instructor. 3 cr.

Performance**(Course Prefix: 75)****75.131 Introduction to Keyboard I**

The emphasis is placed on such keyboard skills as the playing of scales, basic chord progressions, harmonization of melodies, accompaniment patterns, basic solo literature, development of keyboard reading necessary to a working knowledge of the keyboard and basic improvisational concepts. 2 cr.

75.132 Introduction to Keyboard II

A study of more advanced chord progressions, ensemble keyboard playing, patriotic songs, more advanced accompaniment patterns and advanced solo literature and a continuation of the use of improvisational techniques. Prerequisite: 75.131. 2 cr.

75.233 Conducting I

Training in basic baton technique and related study for instrumental and choral conducting. 2 cr.

75.234 Conducting II

Continuation of 75.233 exploring more advanced choral and instrumental conducting techniques. 1 cr.

75.235 Conducting II Lab

Directed toward extension and refinement of conducting skills. 1 cr.

75.253 Keyboard Pedagogy

Emphasis on studio teaching of beginning, intermediate and advanced students. Aspects of establishing and maintaining a studio (business aspects, tax, equipment, bookkeeping, etc.). Survey of literature for teaching purposes; ways of approaching various concepts, such as reading notes, rhythmic understanding, dynamics, etc. 3 cr.

75.254 Keyboard Approaches to Study

Examines various possible ways of learning music and preparing for performance. Covers aspects of practice, facets of memorization and the development of habits which lead to keyboard security. 3 cr.

75.265 Jazz Keyboard I

A study of chord progressions, blues scales, chord voicings and melodic harmonization. 3 cr.

75.266 Jazz Keyboard II

A continuation of 75.265. Will introduce the use of chord substitutions and exten-

sions, melodic analysis and the study of various piano styles. Prerequisite: 75.265. 3 cr.

75.333 Conducting III

A continuation of Conducting II (75.234) for advanced students. Permission of instructor required. Prerequisite: 75.234. 3 cr.

75.334 Conducting for SRT

Provides an intensive study for the SRT student in developing skills in basic conducting and score reading techniques. The emphasis of this course will deal with the development of these skills in diagnosing and correcting ensemble problems and in making informed musical judgments concerning ensemble performance. 3 cr.

75.353 Applied Keyboard Repertoire

The study and performance of smaller and larger works common to the keyboard repertoire: song form, minuet and trio, prelude, intermezzo, nocturne, impromptu, bagatelle and sonata allegro. 3 cr.

75.361 Jazz Improvisation I

A study of basic jazz structures, motives, chord progressions, scales, melodic analysis, use of some approach techniques, tensions and their application to the jazz style. Includes in class performance by small instrumental and/or vocal groups. 3 cr.

75.362 Jazz Improvisation II

A continuation of 75.361. Will emphasize the study and performance of more advanced levels of improvisation. Prerequisite: 75.361. 3 cr.

75.374 Practical Intonation

The study of orchestral and band instruments relative to intonation. The development of conceptual awareness relative to the various characteristics of pitch, which are inherent in the design of the various instruments. Identification of problematic intonation and procedures to alleviate problems through performance. 3 cr.

75.383 Orchestral Repertoire for Winds and Percussion

Designed as a repertoire reading session dealing with the standard literature of the symphony orchestra, with emphasis on the larger works that are heavily scored for winds. The majority of class time will be devoted to a study of articulation, style,

intonation and phrasing as these aspects of the music under consideration relate specifically to the wind instruments. 3 cr.

75.384 Contemporary Repertoire and Performance Techniques

Designed to acquaint the student with various techniques and specialized notational practices from the contemporary repertoire through actual rehearsals, demonstrations and possible student performances. Representative composers include, Berio, Crumb, Ives, Penderecki and Stravinsky. Open to non-performance majors with permission of the instructor. 3 cr.

75.394 Performance Seminar I

The study and performance of selected works from the repertoire of each of the five primary areas of performance; keyboard, voice, woodwinds, strings, and brass/percussion. Emphasis will be placed on student and faculty performance, leading to detailed consideration of the relationship between the demands of the composer and the problems of the performer and the manner in which these concerns influence the musical and artistic judgments necessary to achieve a quality performance. 3 cr.

75.463 Vocal Pedagogy

The study of current techniques in vocal pedagogy examined through discussion, interviews, observation of studio teaching, demonstrations and outside readings. During the second half of the semester, class members are assigned to teach students who have had little or no vocal training. Class members are expected to do some research work on vocal repertoire for beginners and advanced students. The course is also appropriate for conductors and accompanists. 3 cr.

75.464 Diction for the Singer I

The course is designed to acquaint the singer, conductor and accompanist with techniques of enunciation in Italian, German and French as related to the English language. Will include a comparison of sung and spoken language. Students will also learn the International Phonetic Alphabet, which applies for all languages. Song repertoire assignments and performance exercises will be utilized. 3 cr.

75.465 Diction for the Singer II

Continuation of 74.464. 3 cr.

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75.466 Solo Song Repertoire and Performance

An extensive study and research of solo song literature in German, French, Italian and English from all major periods of history. The class will also focus on various historical backgrounds, styles of important composers and poets from many different nations. Students will learn how to select suitable songs appropriate to the basic physical nature of individual voices, as well as the various stages of vocal and intellectual maturity. The class will be exposed to the concepts of preparing, memorizing, performing, recital program building and stage deportment. Students are expected to perform for the class frequently throughout the semester. 3 cr.

75.493 Performance Seminar II

Designed as a "master class" experience for students in each of the five primary areas of performance; keyboard, voice, woodwinds, strings, and brass/percussion, with a separate section for each area wherever possible. Class sessions will consist of student performance of selected literature followed by critical analysis from faculty and peers. Each section will be supervised by the appropriate area coordinator, and will also involve invited guest performers selected from faculty, applied faculty and other noted artists. Note: 75.394 is not a prerequisite for 75.493. 3 cr.

75.495 Directed Study and Research in Performance

Permission of chairperson required. 3 cr.

Ensembles (Course Prefix: 76)**76.101 Chamber Orchestra**

Open to all students by audition. Works from the orchestral repertoire are studied and publicly performed with additional opportunities for choral and solo accompaniment. 2 cr.

76.103 Wind Ensemble

Open to all students by audition. Compositions are selected from a wide repertoire of wind ensemble literature for study and performance. Opportunity for solo performance with wind ensemble accompaniment. 2 cr.

76.105 Concert Band

Open to all students by audition. Selected band repertoire studied and performed. 2 cr.

76.106 Marching Band

Open to all students of the University, without regard for major field of study. The marching band performs at University events and at selected band festivals throughout New England. Custom musical arrangements and visual designs are featured. No audition required. 2 cr.

76.108 Studio Orchestra

Open to all students by audition. A wide spectrum of jazz orchestration and solo performance is studied and performed. 2 cr.

76.147 Ensemble Performance

This ensemble provides students with an introduction to the skills, knowledge, and attitudes necessary for satisfactory ensemble performance, namely: adequate technical facility for successful ensemble participation; functional knowledge of musical grammar and syntax in reference to its application in ensemble performance; proper application of aural and rhythmic skills in an ensemble setting; music sensitivity in relation to ensemble performance; and a knowledge of the protocols of ensemble preparation and performance. Emphasis on utilization of major scales and chords through application in both classical and jazz settings. 2 cr.

76.151 Brass Ensemble

Open to all students by audition. Provides a wide range of performance experience through varied brass literature. 1 cr.

76.152 String Ensemble

Open to all students by audition. Provides experience with string chamber literature. 1 cr.

76.153 Percussion Ensemble

Open to all students by audition. Exploration of the growing body of literature for percussion ensemble. Public performance. 1 cr.

76.155 String Quartet

Open to all students by audition. Study of the best string quartet literature. 1 cr.

76.156 Guitar Ensemble

Open to all students by audition. Provides study and performance of literature for guitar, lute, etc. Required of all guitar majors each semester. 1 cr.

76.157 Woodwind Quintet

Open to all students by audition. Offers study and performance of literature for woodwind quintet. 1 cr.

76.158 Piano Ensemble

Open to all students by audition. Provides performance experiences through varied piano ensemble literature. 1 cr.

76.159 Mixed Chamber Ensemble

Open to all students by audition. Offers a wide range of performance experience through a selection of literature for varying combinations of instruments. 1 cr.

76.160 String Ensemble

Open to all students by audition. Provides experience in the performance of string orchestra literature. 1 cr.

76.161 Small Jazz Ensemble

Open to all students by audition. Provides experience in the performance of jazz literature for groups ranging from four to eight members. 1 cr.

76.162 Jazz Lab Ensemble

Open to all students by audition. Provides students with a clear understanding of the skills, knowledge and attitudes necessary to satisfactory ensemble performance and practical experience in the application of such skills, knowledge and attitudes. 1 cr.

76.163 Mallet Ensemble

Open to all students by audition. The various mallet percussion instruments are used to provide the percussion player an opportunity to experience providing melody and harmony. 1 cr.

76.164 Saxophone Quartet

Open to all students by audition. Offers study and performance of literature for saxophone quartet. 1 cr.

76.165 Jazz Rock Big Band

Open to all students by audition. Fusion big band covering a wide variety of contemporary jazz rock literature. Solo improvisational opportunities. Numerous performances. 1 cr.

76.201 Concert Choir

A small, select choir open to all singers by audition. Performs music ranging from the present day to the Middle Ages. 2 cr.

76.202 University Choir

Open to all students by audition. Includes the study and performance of a wide variety of choral compositions. 2 cr.

76.210 Opera Workshop

Open to all students. Practical experience in the non-performing aspects of operatic and Broadway show production. 1 cr.

76.251 Fine Arts Chorale

A large chorus open to the campus and the community without audition. Performs larger works in the choral repertoire including oratorios, masses, motets and opera. 1 cr.

76.253 Vocal Jazz Ensemble

Open to all students by audition. Provides experience in performing and interpreting vocal jazz literature. Professional microphone and staging techniques will be presented along with vocal improvisation. 1 cr.

Music Business (Course Prefix: 77)

77.101 Music Business I

A systematic look at career options in the Music Industry. Topics discussed include: songwriting, music publishing, national and international copyright law, music licensing, artist management, and concert promotion. 3 cr.

77.102 Music Business II

A systematic look at career options in the Music Industry. Topics include: music merchandising, arts administration, record promotion, marketing, and distribution, radio and television broadcasting, advertising and jingle production, and film scoring. 3 cr.

77.201 Computers in Music Business

An introduction into the use of Macintosh, DOS, and other computer systems and software applications used within the Music Industry and Music Education. Topics will include programs, input devices, disk drives, I/O ports, peripherals, communication networks, operating systems, computer composition, MIDI, sound cards, interactive multi-media, and the use of such applications as: word processors, spreadsheets, data bases, desk top publishing, and music notation, fundamentals, ear training, theory, composition, and arranging. 3 cr.

77.303 Music Publishing, Copyright & Contracts

A thorough study of the legal environment within the Music Industry. Topics discussed include: music publishing, national

and international copyright law, live performance, managers & agents, music organizations, recording agreements, music publishing, film and television music production, music merchandising, and other contractual obligations. 3 cr.

77.304 Music Promotion & Merchandising

A thorough study of the principles and application of marketing, promotion, and distribution of products within the Music Industry. Case studies of various music products and companies will be studied and analyzed. 3 cr.

77.401 Music Business Seminar

Prepares students to undertake their Internship by providing an in-depth study of how to prepare successfully to enter a career path. 3 cr.

77.403 Music Business Entrepreneurship

An thorough study of how to start a business within the Music Industry. Case studies of successful entrepreneurs and their companies will be researched and analyzed. Students will develop a written Business Plan for their own Music Business enterprise. 3 cr.

77.495 Directed Studies in Music Business

Permission of coordinator required. 3 cr.

77.499 Music Business Internship

Students will complete a 15-week Internship at a company in the Music Industry which offers a varied, practical, and challenging learning experience. This Internship will be supervised by a Sponsor from the company and the Coordinator of the Music Business Program. 6 cr.

Sound Recording Technology (Course Prefix: 78)

78.301 Music, Technology & Society

Examines how recording technology has changed music and the relationships of music and society. The course studies and evaluates the application of technology to making music, to music listening, to styles of music, and to music's roles in society, other art forms, and media. The evolving importance of technology in music over the past century is charted through the study of musical examples and through viewing how human values are reflected in

this century's timely music. Studies will be based on assigned readings, lectures and discussions, examinations of current and historically significant music recordings, motion pictures and media pieces for this artistry, their use of available technology, and their impact on human values and society. 3 cr.

78.305 Survey of Music Technology

The use of technology in music listening, performance, analysis, composition, recording and music study will be presented. The dimensions and applications of technology will be discussed as related to aesthetics, the musician's experiences, musical style, and the musical experience. Basic introduction to the technologies of audio recording. Course includes required reading, listening, session participation. Music Majors Only.

78.310 Introduction to Recording

The theory and usage of audio-recording/reproduction components are explored at a basic level and supplemented by hands-on experience. The aesthetics of recording media and their influence on society are discussed in relation to the artistic and commercial functions of the media. Individual research on a subject of interest to the student is required. Prerequisite: permission of Coordinator and Chair. Music Majors. 3 cr.

78.350 Video Production

An introductory course in the fundamentals of video technology and production; encompassing signal transmission, tape formats, transduction, optical characteristics of lenses and cameras, production equipment and procedures, and post-production equipment and techniques; hands-on experience via video and audio for video projects. Permission of Coordinator and Chair. 3 cr.

78.410 Recording Technology I

Intermediate audio production. Planning and executing recording sessions which involve a variety of musical ensembles under diverse recording conditions; live-performance/concert recordings; advanced multi-track recording, overdub, and remix procedures; application of informed musical judgment to the mixing process; and research in recording techniques. Laboratory required. Permission of Coordinator and Chair. 3 cr.

COLLEGE OF FINE ARTS*Music Department***78.411 Recording Technology II**

Advanced audio theory. An in-depth examination of the principles and operating specifications of the major components of the modern recording studio: mastering and multi-track recorders, mixing consoles, microphones, monitoring systems, and signal processing equipment. Recording projects and technical research. Laboratory required. Permission of Coordinator and Chair. 3 cr.

78.420 Sound Synthesis I

Sound synthesis equipment and techniques are studied and supplemented with sound synthesis studio laboratory work. The course will cover practices and principles of analog and digital sound synthesis and their historic origins, related audio equipment and applications, theories of sound samplers and sequencers, and an introduction to MIDI applications in sound synthesis and recording production. Permission of Coordinator and Chair. Prerequisite: 78.310. 3 cr.

78.421 Sound Synthesis II

Advanced sound synthesis techniques are studied and supplemented with sound synthesis studio laboratory work. The course will cover MIDI implementation in analog and digital sound synthesis, the historic origins of computer music and electro-acoustic music, live electronic music performance, audio equipment and applications of MIDI-based and functional devices and processors, advanced music production and sound synthesis via MIDI. Prerequisite: 78.420, permission of Chair. 3 cr.

78.430 Computer Applications in Music

Applications of computers to audio production is emphasized in studies of computer generated and controlled sound sources and devices, algorithmic composition, computer music, digital signal processing, advanced MIDI applications and programming, and computer synchronization of audio and video. Laboratory work required. SRT majors and minors. Permission of Chair. Prerequisite: 92.265. 3 cr.

78.450 The Recording Industry

A detailed survey of the many career options of the audio-recording industry: position duties and responsibilities. Guest lecturers from diverse careers in the industry share their experiences, disciplines, and backgrounds. Permission of Chair. Prerequisite: 78.310. 3 cr.

78.470 Recording Studio Repair And Maintenance

Hands-on experience in repair and maintenance techniques. Common minor repairs and routine maintenance of recording equipment; test equipment and tools; power supplies, op-amps, and low-noise amplifiers; distortion; analog and digital hardware; and interface considerations. Permission of Coordinator. 3 cr.

78.490 Seminar in SRT Technical Research

An open forum is created for students to undertake research projects of a technical nature and that are directly related to SRT. The course will require constant class participation through discussion of research findings and techniques on projects related to audio equipment and applications; theories of operation and design, human interfacing considerations, hardware and software development, enhancing creative flexibility in sound synthesis and recording production. Permission of Chair. Prerequisite: SRT major or minor. 3 cr.

78.493 Internship in SRT

Practical experience in audio-recording under the supervision of a professional firm. At least twenty hours per week for fifteen weeks is spent working at an entry-level position for a firm involved in audio production. Permission of Chair. 6 cr.

78.494 Recording Technology Senior Project

Advanced projects developed in consultation with faculty advisor. Typical projects include production of a complete record album, investigation of experimental recording techniques, and original research in recording technology. To be completed in place of 78.493 by students not choosing an internship. Permission of Chair. 6 cr.

78.495 Directed Study in Sound Recording Technology

Individual work under the supervision of a member of the SRT faculty on a topic or area of production approved by the instructor and the Coordinator of SRT. Permission of Chair. 3 cr.

Faculty

Gerald J. Lloyd, B.M., M.M., Ph.D., Dean

Department Chairpersons

Fred Faudie, A.B., M.A., M.F.A., Art

Anthony Mele, B.M., M.M., Music

Resident Faculty**Art**

James Coates, Associate Professor, Sculpture; B.F.A., University of South Carolina; M.F.A., Clemson University

Frederic Faudie, Professor, Painting and Illustration; A.B., Cornell University; M.A., University of Iowa; M.F.A., Syracuse University

Robert Griffith, Associate Professor Emeritus, Visual Design; B.S. Ed., Massachusetts College of Art; M.F.A., Pratt Institute

Arno Minkinen, Professor, Photography and Advertising; B.A., Wagner College; M.F.A., Rhode Island School of Design

Brenda Pinardi, Professor, Painting and Drawing; B.S. Ed., Massachusetts College of Art; M.F.A., Rhode Island School of Design

James Veatch, Associate Professor, Studio/Graphic Design; B.S., State University of New York at Brockport; M.F.A., Rochester Institute of Technology

Music

Ruth Ashley, Associate Professor Emeritus, Music Education; B.S. Ed., Lowell State College; M.Ed., Fitchburg State College

Dean Bouzianis, Associate Professor, Music Theory & Composition; B.M., M.A., Boston University; M.M., National Conservatory of Greece; D.M.A., Boston University

Donald Bravo, Professor Emeritus, Performance; B.M., New England Conservatory; M.M. Boston Conservatory

Jacqueline Charette, Associate Professor, Music Theory; M.M., Rivier College; Ed.D., Boston University

Alma O. Espinosa, Professor, Music History & Literature; B.M., Eastman School of Music; M.M., Pius XII Institute-Florence, Italy; M.A., Ph.D., New York University

Scott Fredrickson, Associate Professor, Music Business; B.A., California State University Fullerton; M.B.A., Pepperdine University; D.A., University of Northern Colorado

Paul Gay, Professor, Music Theory, Composition; B.M., New England Conservatory; M.M., Boston University

Paul Gayzagian, Professor Emeritus, Music Education; B.M., M.M., Ed.D., Boston University

Antone Holevas, Associate Professor Emeritus, Music Theory; B.M. Butler University; M.M., Boston University

Gerald J. Lloyd, Professor, Music Theory, Composition, and Literature; B.M., M.M., College-Conservatory of Music, University of Cincinnati; Ph.D., Eastman School of Music

David Martins, Professor, Performance; B.M., Eastman School of Music; M.M., University of Lowell

Christopher McGahan, Professor, Performance; B.A., University of Massachusetts at Amherst; M.M., University of Wisconsin-Madison; D.M.A., University of Illinois-Urbana/Champaign

Anthony Mele, Professor, Performance; B.M., Ithaca College; M.M., Boston University

William Moylan, Professor, Sound Recording Technology; B.M., Peabody Conservatory; M.M., University of Toronto; D.A., Ball State University

Ingul Ivan Oak, Associate Professor, Performance; B.M., M.M., New England Conservatory

John Ogasapian, Professor, Music History & Literature; B.M., M.M., Ph.D., Boston University

Natalo Paella, Professor Emeritus, Performance; B.M., Louisiana State University; M.M., New England Conservatory

Kay George Roberts, Professor, Performance; B.A., Fisk University; M.M., M.M.A., D.M.A., Yale University

Rosita Sands, Professor, Music Education; B.M.Ed., M.A., Florida State University; M.Ed., Ed.D., Columbia University

Rawen Spearman, Professor Emeritus, Music Business; B.S., Florida A&M University; M.A., Ed.D., Columbia University

Paula Telesco, Asst. Professor, Music Theory; B.A., S.U.N.Y. College at Buffalo; M.M., University of Arizona; Ph.D., Ohio State University

Willis Traphagan, Professor Emeritus, Performance; B.A., Ithaca College; M.M., Boston University

W. Anne Trenkamp, Professor, Music Theory; B.A., Ph.D., Case-Western Reserve University; M.M., University of Michigan

Robert White, Professor Emeritus, Performance; M.M., New England Conservatory; M.A., Harvard University; D.M.A., Boston University

Adjunct Faculty

Eunice Alberts, Voice; B.M., New England Conservatory

Anne Black, Violin; B.A., University of California; M.M., Yale

Fred Buda, Percussion; B.M., Boston University

William Buonocore, Guitar; B.A., William Patterson College; M.M., Boston Conservatory

Carlson-Wood, Sandra, Woodwinds; B.S., University of New Hampshire, M.M., University of Massachusetts Lowell

Chin, Chia-Chi, Keyboard; B.M., M.M., University of Massachusetts Lowell

Jeffrey Dorenfeld, Music Business; B.A., California State University/Sonoma

Thomas Ferrante, Saxophone; B.M., M.M., New England Conservatory

Jeffrey Fischer, Percussion; B.A., New England Conservatory

Janice Giampa, Voice; B.M., University of Connecticut; M.M., Yale

Richard Given, Trumpet; Artist Diploma, New England Conservatory

Richard Greenblatt, Instrumental Music; M.M., University of Lowell

Mark Henry, Double Bass; B.A., Berklee College of Music

Tad Hitchcock, Guitar

Leon Janikian, Sound Recording Technology; B.A., Mark Hopkins College; M.M., University of Massachusetts at Amherst

Keith Jones, Sound Recording Technology; B.A., Hartwick College, M.A., San Francisco State University; M.A., Ph.D., Stanford University

James Lattini, Instrumental Music; B.M., University of Lowell; M.M. Boston University

Paul Lehrman, Sound Recording Technology; B.F.A., SUNY/Purchase

Daniel Lutz, Music Performance; B.M., Berklee College of Music

William MacMullen, Music Education

Joseph McGauley, Violin; B.A., SUNY/Albany; M.M., Yale University

Ellen Michaud-Martins, French Horn; B.M., University of Lowell; M.M., New England Conservatory

Martin Polon, Sound Recording Technology; B.A., M.A. UCLA

Coleman Rogers, Sound Recording Technology, B.M. Brown University

Marilyn Roth, Piano; B.F.A., Carnegie Mellon University; M.M., New England Conservatory

Terry Sinskie, Keyboard; B.M., University of Maine; M.M., University of Lowell

John Skelton, Organ; B.M., M.M., New England Conservatory

David Thibodeau, Sound Recording Technology; B.S., Middle Tennessee State University

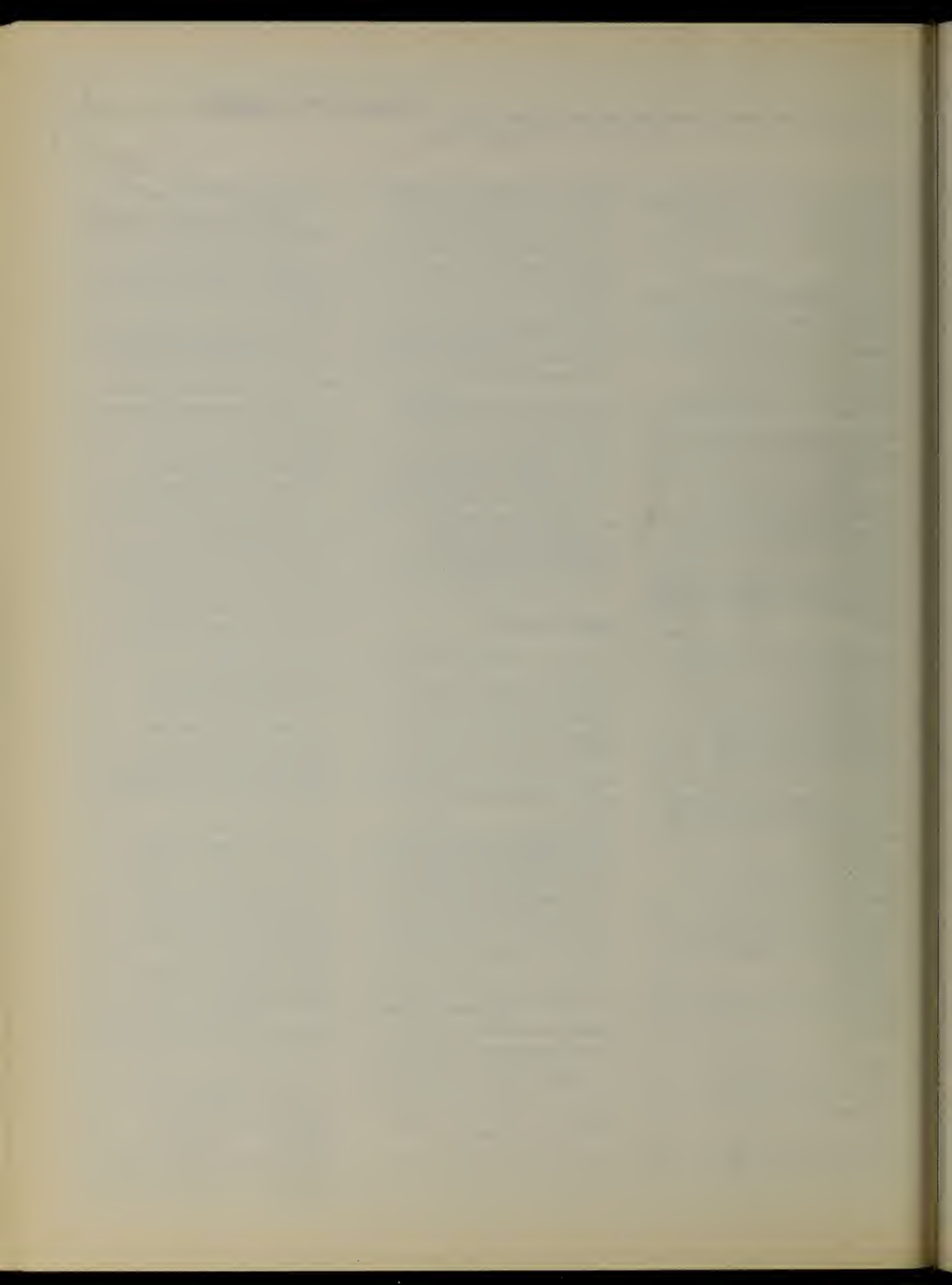
Juanita Tsu, Piano; B.M., Peabody Conservatory of Music; M.M., New England Conservatory

Susan Turcotte-Gavriel, Music Education; B.M. University of Massachusetts Lowell

Jon Wheatley, Guitar

Alan Williams, Sound Recording Technology; B.M., New England Conservatory

Douglas Worthen, Flute; B.M., B.M.E., Hartt School of Music; M.M. New England Conservatory



College of Health Professions



The faculty of the College of Health Professions believe that each individual has the right to achieve and to maintain an optimal level of health. As a response to society's need for individuals to exercise this right, the College of Health Professions provides programs to prepare health professionals on both an undergraduate and graduate level. The undergraduate programs prepare the students as generalists in their chosen health profession; while specialization in the graduate programs provides greater depth in knowledge, attitudes, and skills necessary for leadership in the health professions.

Janice Stecchi, Dean

COLLEGE OF HEALTH PROFESSIONS

College Policies and Requirements

Mission of the College of Health Professions

The mission of the college is to educate students who will become competent health professionals.

The mission is achieved through:

1. The teaching of theory and practice in classroom and community based settings,
2. research into the discovery and dissemination of new knowledge and
3. active service in health care institutions and multicultural settings.

These components are integrated throughout the programs to promote the optimal health of individuals, families and communities to support a strong economy.

College Organization and Governance

The College of Health Professions is organized into three departments and is administered by a dean who is assisted by an executive committee. Each of the departments is responsible for developing programs of study and course offerings. Although the faculty of the college has overall responsibility for all academic policies of the college, the academic standards committee is responsible for enforcing the academic standards of the college and also serves as a review body for suspended students seeking readmission with probationary status. In addition, each department has its own professional review committee which evaluates appeals from students who have not met the criteria for retention in their specific programs. Such appeals to professional review committees may be submitted only once, and all decisions of the faculty are final.

Executive Committee

Janice Stecchi, Dean

Beverly Volicer, Chairperson, Health & Clinical Sciences

May Futrell, Chairperson, Nursing

Joseph Dorsey, Chairperson, Physical Therapy

Baccalaureate Degree Programs

The College of Health Professions offers undergraduate programs leading to the degree of Bachelor of Science with majors in Clinical Laboratory Sciences, Health Education, Exercise Physiology and Nursing. For information concerning graduate offerings of the college, see the Graduate School Catalogue.

The course requirements for undergraduate programs of the college have been determined by specific professional objectives and are subject to the recommendations of the various professional accrediting associations. Each course of study provides a basic general education in the sciences, the psycho-social areas, and the humanities; a comprehensive introduction to the health professions; upper division professional courses; and clinical or teaching experiences in one or more community health agencies or schools. Candidates for the Bachelor of Science degree in the College of Health Professions must comply with the University general education requirements and with the rules and regulations of the College of Health Professions. The University general education requirements are described in the "Academic Policies" section of this catalogue.

Candidates for degrees in the College of Health Professions may be permitted to elect a second academic major or a minor in another college provided that all curriculum requirements of the College of Health Professions can still be satisfied. Election of a second major or minor may require an extension of the normal four-year period of undergraduate study for all but the unusual student.

General College Requirements

Candidates for the baccalaureate degree in the College of Health Professions must satisfy the general University requirements for graduation, complete all courses and credits as required by the specific program of study, and meet the academic requirements of the College of Health Professions as specified in this section.

Retention and Continuance in College Programs

Irrespective of the classification policies of the University, students shall not be admitted to professional courses of the College unless they have satisfactorily completed all courses which are specified in their programs of study for the first two semesters and have achieved a cumulative grade-point average of 2.50 or better for all such courses. Students enrolled in exercise physiology, medical technology, clinical sciences, and nursing also are required to achieve at this time a cumulative grade-point average of 2.50 or better in their required physical and biological science courses.

To qualify for continued matriculation in programs of the College of Health Professions, all students must maintain on-going cumulative averages of 2.50 or better by achieving the following averages at the end of the end of the freshman year and at the end of each semester thereafter: 1) a semester average of 2.50 or better, 2) not less than a grade 'C' in any professional major course and 3) a semester average of 2.50 or better for professional courses attempted in the major. Students enrolled in exercise physiology, medical technology, clinical sciences, and nursing must maintain a cumulative grade point average of 2.50 or better in their required physical and biological science courses. Students who fail to satisfy these requirements will be dismissed from their respective programs. Such students may seek reinstatement to programs by filing a petition with the professional review committee of their respective departments. Students whose petitions for reinstatement are denied may seek transfer to another major within the University if they qualify under University policies as students with satisfactory academic standing. Students who do not qualify for such standing are dismissed from the University at the time they are dismissed from the College of Health Professions and are ineligible for readmission as probationary students in the College of Health Professions.

All students in the College of Health Professions must demonstrate a level of professionalism and a state of emotional and physical health which will enable them to provide safe competent practice in their chosen professional field. In special cases, at the request of the professional review committee of the student's major

College Policies and Requirements

department, an individual may be required to present statements of physical and/or mental health from appropriate physicians or psychiatrists who are fully licensed by the Commonwealth of Massachusetts. On the basis of a review of such statements, the professional review committee may recommend to the chairperson of the student's major department that the individual be denied admission to or continuance in the major program.

Appeals Procedure for Reinstatement

Students who have been denied continuance in their majors, or students who have been dismissed from a major for non-academic reasons concerning a lack of professionalism, emotional and/or physical health, may submit a written petition, in response to the letter of notification received, to the appropriate professional review committee for re-evaluation of their transcripts for the purpose of reinstatement. This petition must be received no later than the date specified in the letter of notification and may be submitted only once. In making recommendation for reinstatement, the professional review committee may recommend to the faculty specific requirements which students must satisfy as a condition of their reinstatement. The faculty will vote to accept or reject the request for reinstatement and will forward to the department chairperson and the Dean its recommendations together with a statement of requirements which reinstated students must satisfy as a special condition of their reinstatement and continued matriculation. Students who have been dismissed from their programs after having been reinstated may not petition again for reinstatement.

Academic Advising

Students in the College of Health Professions are assigned an academic advisor. Prior to each registration period, students should meet with their advisor to discuss selection of courses required by their academic programs. Students who fail to avail themselves of this opportunity and who register for incorrect courses may find it necessary to extend their period of study and may be ineligible to continue in their major. All seniors must consult with their advisors prior to the established University deadline for filing program of study forms with the office of the dean.

The program of study summarizes senior-level status with respect to requirements of the curriculum and grade-point averages and insures that all stated requirements for graduation are satisfied.

Declaration of Program and Change of Program

Students entering the College of Health Professions are advised to declare a major at the time of admission. Students interested in the health professions but who are unsure of a specific major, or, students who meet the college admissions standards but do not meet the admissions requirement for a specific major, may be admitted to the college as "undeclared" health students. Undeclared health students follow the same general course of study as declared majors during their freshmen year and sophomore first semester.

All students are required to declare a major prior to the beginning of second semester of the sophomore year. Consequently, students may not retain the undeclared status later than the semester in which they have earned 60 credits. All qualifying undeclared health students can select a major in the College; however, selection of a specific major may be restricted due to non-availability of spaces in a particular program. Whenever students make a declaration of major, they are required to first obtain approval from the department Chair and then file an official notification with the Office of Enrollment Services.

Students desiring to change their professional program within the College of Health Professions must secure the approval of the chairperson of the appropriate department. Students transferring to another major outside the College of Health Professions must apply for intercollegiate transfer. All changes of program require official notification of the Office of the Enrollment Services. Students who change their programs within the College of Health Professions after the first semester of the sophomore year should expect possible additional course work beyond the minimum degree requirements and extension of the normal four-year period of study.

Transfer Policies

Qualified students may transfer from other colleges in the University into specified degree programs of the College of Health Professions, on a space available basis, provided they meet the requirements as stated. Irrespective of any previous recognition by the Office of Admissions or by other colleges of the University, a student transferring from another college of the University to the College of Health Professions must meet prerequisites and academic criteria for admission to programs of the college. Students may not transfer directly into Exercise Physiology but must obtain "undeclared health status" prior to review for acceptance into Exercise Physiology.

Students who contemplate transferring to one of the health professions majors are advised that admission to the college is competitive and requires, as a minimum, the achievement of a cumulative grade-point average of 2.50 on a 4.00 scale for all previous course work attempted. In addition, applicants for exercise physiology, medical technology, clinical sciences, and nursing, are also required to have achieved a minimum of 2.50 in their science courses.

Transfer from Other Institutions

Courses transferred from other institutions are initially evaluated by the Office of Admissions in terms of general university requirements. When students are admitted to the University, they are also evaluated by the professional department in terms of college and program requirements. Courses which are transferred to the University either under provisions of the Commonwealth Transfer Compact and which are not equivalent to those of the College of Health Professions or as unrestricted elective courses will be listed on students' transcripts but will not apply to the minimum degree requirements. In the event that students who have transferred to the University under the Commonwealth Transfer Compact subsequently make an intercollegiate transfer to the College of Health Professions, all previously completed courses, including transferred courses from the compact institution, will be re-evaluated in terms of their applicability to degree requirements of the College of Health Professions. All students must satisfy all general education,

COLLEGE OF HEALTH PROFESSIONS

College Policies and Requirements

prerequisite and corequisite requirements, plus all courses in the major to be eligible for the Bachelor of Science degree from the College of Health Professions.

The applicability of grades earned in transferred courses for the determination of the grade-point average of students majors at the University is determined by policies of each of the colleges. The policy of the College of Health Professions is to count such grades for required physical and biological science courses for the purpose of determining the students' science grade-point average in their professional majors. All undeclared students must declare a major by the completion of 60 credits. Transfer students may request exception to this rule to have the opportunity to have "undeclared health status" while attempting to declare exercise physiology. These students will be allowed two semesters in Undeclared Health. Transfer students are not accepted directly into Exercise Physiology but must apply for Undeclared Health status.

Transfer Policies for Certified Laboratory Technicians

Current practitioners in the field including associate degree graduates, with MLT (ASCP) or CLA (ASCP) certification may seek entry to the Department of Clinical Laboratory Sciences through transfer of credits. Prerequisite courses greater than seven years old must be updated. Comparable didactic courses are available for challenge in the clinical practice and upper division courses.

Repetition of Transferred Courses

Students who have been granted transfer credit, and, on this basis, have been assigned to advanced courses for which the transferred course is a prerequisite, may be advised to repeat such transferred work at the University or to take a more elementary course than that which has been transferred when the competence of the student has been demonstrably inadequate. Permission to repeat a transferred course is granted by filing an academic petition form through the Office of the Dean. Since credit may not be granted more than once for the completion of any course, a condition for filing such a petition is the simultaneous filing of a request to revoke recognition of the previously transferred course.

Intercollegiate Transfer to the College of Health Professions

Students wishing to transfer from another college of the University, or from baccalaureate continuing education programs of University College, must file a petition, together with a current transcript, with the appropriate chairperson and the Dean of the College of Health Professions.

Students should refer to University policies concerning intercollegiate transfer "Academic Policies: Change of Major with Intercollegiate Transfer" for further procedural details.

Readmission Policies

Students who are readmitted by the department chairperson on a space available basis into their major in the College of Health Professions must comply with the current program requirements of that major. Year of graduation based on students' previous matriculation dates becomes null and void on readmission.

Special College Requirements

All students are expected to demonstrate behavior that is generally accepted as professional. All students must demonstrate proof of purchase of professional liability insurance at the beginning of their junior year. Students are billed for this insurance by the business office, but in case of error or omission, students are advised that they must assume personal responsibility for their coverage.

In order to participate in the clinical portion of the upper-division curriculum, all College of Health Professions students are required to be aware of their rights and responsibilities under the Massachusetts Right to Know Law. All students must supply documentation that they have completed a basic CPR course prior to entering their first clinical course. Thereafter, current CPR documentation must be presented annually for departmental approval. Each student must provide evidence that he or she is free of tuberculosis by presenting a mantoux skin test or x-ray report before enrolling in any clinical or teaching experience.

Massachusetts law requires that all students in the College of Health Professions present certification of immunization for the following:

First Measles (Rubeola) or Measles/Mumps/Rubella (MMR) vaccine;

Second Measles or Measles/Mumps/Rubella vaccine

(one of the MMR vaccines must have been received in/after 1980. Titers indicating immunity are acceptable for Rubeola and Rubella);

Chicken Pox (Varicella) - Evidence of disease or titer indicating immunity; Tetanus/Diphtheria (DT) (repeated every 10 years); and

Hepatitis Vaccine (three doses & titer) recommended or waiver must be signed.

Other health requirements may be mandated for specific affiliations. For a list of additional certification requirements imposed by the University on all students, refer to "Health Certification Requirements" in the Admissions section of this catalogue. In addition students in all majors must present a report of a complete physical examination before clinical experiences are scheduled. These reports are to be submitted to students' respective departments. Students are advised to consult department chairpersons for additional details.

Each exercise physiology, medical technology, and nursing student is required to wear an official school uniform when in the clinical setting. Details concerning specific uniform requirements may be secured from the appropriate department chairperson. Final decisions regarding clinical placements are the responsibility of

the faculty of the department. All students must provide their own transportation to clinical placements. Car pools are often arranged among students.

Interdisciplinary Courses (Course Prefix: 30)

The following courses are offered by faculty of the several departments of the College of Health Professions and are available for election by students who are enrolled in other colleges. Registration in these courses does not guarantee non-majors a space in health professions programs.

30.120 Life Skills

This course is designed to assist new students adjust to, and succeed in college and beyond. Course subject matter has been created in conjunction with the National Collegiate Athletic Association (NCAA). This course has been specifically designed to meet the needs of the student-athletes who are current members of our campus community. Successful completion of this course will give the participants the skills necessary to be successful students, athletes and citizens academically, socially, personally and professionally. I, II(3,0)3

30.201 Community Health

This course emphasizes the concepts, philosophy and principles of public health and their relationship to the physical, mental and social well-being of the community. The focus is on the prevention of disease, the promotion and maintenance of health and the provision of environmental and personal health services through organized community effort. College faculty. I,II(3,0)3

30.206 Human Nutrition

This course provides an overview of nutrition and the components of a "nutritious diet" during the various stages of the life cycle. It emphasizes the impact of nutrition on the major contemporary health problems in the United States. Nutrition issues, trends and research, and their effect on society and the legislative process will be explored. Nicolosi. I,II(3,0)3

30.301 Research and Health Care

This course focuses on the research process, examples of knowledge derived from research, and the application of this knowledge to health care. Various health care disciplines' research interests are studied for similarities and differences. The role of the media in presenting research findings in chronic and infectious diseases and environmental health hazards is also examined. Coppins. I(3,0)3

30.306 Introduction to Gerontology

This course examines human aging from a multi-disciplinary and developmental perspective. The course will focus on the adult years of the life span. The social-psychological factors involved in adjustments to the aging process, to retirement, to family, to leisure, to aloneness, to death and bereavement are discussed together with such special concerns of the elderly as widowhood, finances, religion, sexuality

and health problems. Rehabilitative strategies such as remotivation and reality orientation are included. Williamson. I,II(3,0)3

30.307 Lifestyles/Health Behaviors/Physiology

This course provides an overview of selected current health issues. Information necessary for making well-reasoned, responsible decisions about one's health will be presented and discussed. Personal and societal attitudes, beliefs, and values implicit to the decision-making process will be explored as they relate to health behavior and consequently, to health. Champagne, Neal. II(0,3)3

Department of Health and Clinical Sciences

Beverly Volicer, Chairperson

Professors: Alease S. Bruce, Kathleen Doyle, Sandra Fessia, Jacob W. Lam, Theodore Namm, Robert Neal, Robert Nicolosi, Eugene Rogers, Beverly Volicer

Associate Professors: Michael Frechette, Shashikant Mehta, Vincent Pivnicny

Assistant Professors: Mary Hooker, Michael O'Sullivan

Instructor: Nicole Champagne

Health Education Major

The Department of Health and Clinical Sciences offers a major in Health Education, leading to the degree of Bachelor of Science, a masters program in Health Services Administration, leading to a Master of Science, and a Graduate Certificate in Health Services Administration. Please see the Graduate School Catalogue for information concerning the graduate programs. Faculty of the Department believe that society, through its community and educational institutions, has a responsibility to make available for its citizens the methods and means for achieving the goal of optimal health. To this end, the department is committed to preparing professional health educators who can assist the community in achieving as high a level of health as is possible.

The College of Health Professions' Health Education Program endeavors to provide a high level of professional preparation for health educators. This program provides a basis for understanding the scientific foundation of health education, community needs in their social and political context, and how to address those needs through program development and implementation. Graduates will be prepared to facilitate voluntary change in health behaviors and reinforce positive health behavior through effective health education programs in a variety of community and educational settings.

Students in this major may select either a community practicum or an apprentice teaching practicum during their senior year. Those opting for the teaching practicum are eligible upon graduation to receive provisional certification for teach-

COLLEGE OF HEALTH PROFESSIONS

Department of Health and Clinical Sciences

ing health education from The Commonwealth of Massachusetts Department of Education. The program is accredited through NCATE.

Health education has emerged as an educational discipline to effectively meet society's ever-increasing need for accurate health knowledge. Health education builds its body of knowledge on the arts and sciences and deals with the theory of health science. The application of this theory to practice requires the development of necessary effective teaching skills. These skills include the knowledge of developing curriculum based on health theory. This application also requires the acquisition of a variety of teaching and evaluation skills that are integral to effective health education. In addition, health-based curriculum and teaching plans for changing negative health attitudes and behavior are developed to reinforce existing positive health attitudes and behavior. Health educators must be able to communicate effectively, particularly in the areas of public speaking and be able to maintain good relations with people of all ages. The goal of the health education program is to prepare entry level professional practitioners who have a foundation for continuing professional development and individual growth in addition to the ability to function effectively in a variety of settings.

At the completion of the health education program, the graduating student will be expected to:

1. Teach effectively and demonstrate mastery in the major areas of health education curriculum development;
2. Incorporate in the teaching process and interactions with people the broad-based areas of knowledge existing in the liberal arts and biological sciences;
3. Recognize and acknowledge the multicultural diversity of populations and incorporate this understanding into educational and professional practices;
4. Assess needs effectively and develop, present, and evaluate health education programs;
5. Demonstrate knowledge about research, current trends and issues in the areas of general education and health education for continued professional and personal growth;
6. Be an active participant in developing

national awareness for disease prevention and increasing the quality of life for all citizens, individually and collectively, through health education; and

7. Appreciate the applicability of computer technology to instruction and evaluation in health education.

Course of Study for Health Education

Freshman Year

Fall Semester

30.201	Community Health	3
35.101	Anatomy and Physiology I	3
35.103	Anatomy and Physiology Lab I	1
42.101	College Writing I	3
47.101	General Psychology	3
48.101	Introduction to Sociology	3
	Behavioral/ Soc. Sci. Elective	3
(FROM DEPT. OTHER THAN PSYCHOLOGY)		16

Spring Semester

35.102	A & P II	3
35.104	Anatomy and Phys Lab II	1
42.102	College Writing II	3
47.260	Human Development I	3
	History Elective	3
	Open Elective	3
		16

Sophomore Year

Fall Semester

35.251	Physiological Chem I	3
35.253	Physiological Chem Lab I	1
92.183	Intro to Statistics OR	
92.283	Statistics for Behav. Sciences	3
	Literature Elective	3
	Aesthetics Elective	3
	Values Elective	3
		16

Spring Semester

30.206	Human Nutrition	3
30.301	Research and Health Care	3
31.204	Intro Health Ed	3
35.211	Basic Clin Micro/Pathol	3
35.213	Basic Clin/Micro/Pathol Lab I	1
35.252	Physiological Chem II	3
35.254	Physiological Chem Lab II	1
		17

Junior Year*

Fall Semester

01.391	Philosophy of Education	3
31.303	Contemp Health Problems I*	3
31.301	Curric/Methods for Tchg Hlth*	3
47.328	Dynamics Interpers Rels.	3
31.302	Compu Meth for Tchg Hlth*	3
		15

Spring Semester

30.306	Intro to Gerontology ORr	
47.360	Human Development II	3
31.304	Contemp Hlth Probs II**	3
31.305	Intro to Epidemiology**	3
01.373	Teaching & Learning Strategies OR	
01.371	Educational Psychology	3
	Open Elective	3
		15

Senior Year

Fall Semester

31.403	Principles Hlth Counseling***	3
31.405	Communic Tech/Hlth Prom***	4
31.407	Health Care Systems***	3
31.409	Commun Hlth Prepracticum OR	
31.411	Teaching Sch Hlth Prepract	3
		13

Spring Semester

31.410	Community Health Pract OR	
31.412	Teaching School Health	12
		12

Total credits required 120

*31.301, 31.302, 31.303 must be taken concurrently in fall of junior year.

**31.403, 31.405 must be taken concurrently in fall of senior year; 31.407 may be taken either in the spring of junior year or fall of senior year.

All students are required to have current CPR/First Aid Certification and Current Immunization Documentation prior to beginning the 31.409 Community Health Prepracticum or 31.411 Teaching School Health Prepracticum in the fall of the senior year.

Health Education (Course Prefix: 31)

31.204 Introduction to Health Education

Focuses on the role that school and community health education play in the development of healthful patterns of living. A philosophy of health education is developed. Methods of appraisal and the organization of health education are discussed. The organization and the administration of school, community and worksite health education programs are introduced. II(3,0)3

31.301 Curriculum and Methods for Teaching Education

Focuses on education methods and the various aspects and dimensions of curriculum development and planning, importance and ramifications of needs assessments, current trends and issues in the field of health education and health promotion teaching strategies, and the development of a viable health curriculum. Juniors only. I(3,0)3

31.302 Computer Methods in Health Education

Focuses on methods for using computer technology for health education programs in school, community, and occupational settings. Applications of microcomputers in program administration, teaching, and evaluation are discussed, demonstrated, and practiced. Students will review and evaluate a wide variety of computer software used in health education and develop software for computer-assisted instruction in health. Juniors only. I(3,0)3

31.303 Contemporary Health Problems I

Presents students with detailed knowledge of major contemporary health problems and issues. Assessment of individual health needs is discussed and a model for self-directed behavior change is developed. The role of health education in the prevention of disease is covered. Juniors only. I(3,0)3

31.304 Contemporary Health Problems II

Presents students with detailed knowledge of major contemporary health problems, issues and concerns. The course has been developed in concert with Contemporary Health Problems I and is an academic progression relative to the topics, concepts and health education initiatives in the treatment and prevention of disease. Juniors only. Prerequisite: 31.303 II(3,0)3

31.305 Epidemiology for Planning and Evaluation

This course is designed to introduce basic epidemiological methods used in the study of current major health problems. Content includes an explanation of historical shifts in population and disease patterns, types of research designs, and simple measures of disease frequency and association used in the study of the distribution and determinants of disease. Emphasis is on applications of epidemiological methods and findings in health education. Juniors only. II(3,0)3

31.403 Principles in Health Counseling

Health counseling develops an understanding of the theory and practice of counseling, and stresses the idea that self-esteem is a basic determinant of mental health. A positive model of mental health is developed and techniques of dealing with life stresses are discussed with the objective of implementing these concepts in the health curriculum. Methods of guiding group discussions and developing programs of self-directed behavior change are covered. Seniors only. I(3,0)3

31.405 Communication Techniques in Health Promotion

This course focuses on communication techniques and mass media approaches and materials necessary to promote and implement effective community health promotion programs. Seniors only. I(3,0)4

31.407 Health Care Systems

This course describes and analyzes the nature and functions of health care services and health professionals. The course examines the impact of social, political, economic, ethical, professional, legal, and technological forces on them and the system they comprise. Seniors only. I,II (3,0)3

31.409 Community Health Education Prepracticum

Prepracticum field experience and seminar, one day a week (seven hours) for fifteen weeks, for students wanting a community health education focus. Student are placed in a community agency, health organization, or corporate setting, and are introduced to the organization, roles and responsibilities of personnel, and actively participate in entry level activities. Placement is arranged by university faculty supervisors. Seniors only. I(0,7)3

31.410 Community Health Education Practicum

Full-time health education field experience (35 hours per week), for students wanting a community health education focus. Students continue at the prepracticum site, participating in the development, implementation and evaluation of health education programs and take an active part in the total community health education process. Seniors only. II(0,35)12

31.411 Teaching School Health Prepracticum

Prepracticum field experience and seminar, one day a week (seven hours) for fifteen weeks, for students wanting secondary level certification for teaching health education. Student are placed in a middle school or high school to begin an orientation to practice teaching in a health education program. Placement is arranged by university faculty supervisors. Seniors only. I(0,7)3

31.412 Teaching School Health

Full-time health education practice teaching experience (35 hours per week), for students wanting secondary level certification for teaching health education. Students continue in the prepracticum school and complete the practice teaching required for provision certification by the Commonwealth of Massachusetts. Seniors only. II(0,35)12

Clinical Laboratory Sciences Major

The Department of Health and Clinical Sciences offers a major which leads to a Bachelor of Science degree in Clinical Laboratory Sciences. Students may select either of two options: Medical Technology or Clinical Sciences. The Department also offers a minor in Clinical Laboratory Sciences and a Minor in Nutrition. Additionally, the Department offers a Master's Degree in Clinical Laboratory Sciences and a Graduate Certificate in Clinical Pathology. Please see the Graduate School Catalogue for information concerning the graduate programs.

COLLEGE OF HEALTH PROFESSIONS*Department of Health and Clinical Sciences***Medical Technology Option**

Graduates of the medical technology option are qualified to write either or both of the registry examinations sponsored by the American Society of Clinical Pathologists MT (ASCP) and the National Certifying Agency for Clinical Laboratory Personnel CLS (NCA). This option provides the student with the scientific knowledge, technical skills, and hands-on experience required to function in all areas of the clinical laboratory. This integrated curriculum is offered in cooperation with the clinical laboratories of hospitals, medical centers and health maintenance organizations (HMO's) in the Lowell, Lawrence, Northshore and Greater Boston areas. On campus instruction provides student with didactic and simulated clinical laboratory experiences in each of the five major areas of the clinical laboratory: chemistry, hematology, immunohematology, microbiology and immunology. Hospital-based clinical rotations are integrated with the didactic laboratory curriculum during the junior and senior years of the program.

This option allows for upward mobility of current practitioners in the field, including associate degree graduates with MLT (ASCP) certification or CLT (NCA) certification. The growing complexity and significance of the role of the clinical laboratory in the delivery of health care accentuates the importance to its professionals receiving an education commensurate with the responsibilities of the clinical laboratory scientist. Medical technologists perform tests on various body fluids and tissues to determine the presence or absence of disease, to monitor response to disease, and to aid in health maintenance. They are indispensable laboratory personnel - the supervisors, the instructors and/or the specialists for a wide range of complex diagnostic and therapeutic procedures. In addition, graduates of the program are prepared for graduate studies and/or employment in clinically related government and/or industrial settings.

Technical Standards for Admission

In order to be successful on the Clinical Laboratory Sciences Major prospective students must meet the following non-academic criteria (technical standards):

1. Observation The student must be able to participate actively in laboratory exercises and clinical experiences;

2. Communication The student must be able to communicate with fellow students, faculty, staff and members of a health care team;
3. Motor The student must have sufficient motor skills to perform basic diagnostic tests;
4. Intellectual/Conceptual, Integrative and Quantitative Abilities The student must be able to problem solve and comprehend spatial relationships of structures; and
5. Behavioral and Social Attributes The student must be able to exercise good judgment, function effectively under stress, display flexibility, and have acceptable personal hygiene..

Transfer Policies for Certified Laboratory Technicians

Current practitioners in the field, including associate degree graduates, with MLT (ASCP), CLT (NCA), or CLA (ASCP) certification may seek entry to the major through transfer of credits. Prerequisite courses greater than seven years old must be updated. Comparable didactic courses are available for challenge in the clinical practice and upper division courses.

In accordance with NAACLS, after completion of this program, the medical technologist will be able to:

1. collect and process biological specimens for analysis;
2. perform analytical tests on body fluids, cells and products;
3. integrate and relate data in making critical judgments;
4. evaluate the results of quality control and institute corrective procedures;
5. perform preventive and corrective maintenance of equipment and instrument or refer to appropriate source;
6. evaluate new techniques and procedures for usefulness and practicality within the context of personnel, equipment, space and budget resources;
7. demonstrate concern for the patient and cooperate with others in the medical community;
8. communicate effectively with others;
9. assume responsibility for continuing

professional development and competence;

10. assume leadership to effect positive changes in the profession; and
11. apply principles of management, supervision and educational methodology.

Accreditation

The Medical Technology option of the Department of Clinical Laboratory Sciences is accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS).

Program Director: Kathleen Doyle, Ph.D., MT(ASCP)

Medical Director: David McGoldrick, M.D.

Course of Study for Clinical Laboratory Sciences**Medical Technology Option****Freshman Year****Fall Semester**

35.101	Human A & P I	3
35.103	Human A & P I Lab	1
42.101	College Writing I	3
47.101	General Psychology (Behav)	3
48.101	Intro to Sociology (Soc Sci)	3
92.121	Precalculus (Math) or	
92.127	Calculus IA (Math)	3
		16

Spring Semester

30.201	Community Health	3
35.102	Human Anatomy & Phys II	3
35.104	Human Anatomy & Phys II Lab	1
36.273	Intro to Clinical Lab Sci	2
42.102	College Writing & Lit	3
	Values Elective	3
		15

Sophomore Year**Fall Semester**

35.211	Basic Clin Micro & Pathology	3
35.213	Basic Clin Micro & Patho Lab I	
35.251	Physiological Chemistry I	3
35.253	Physiological Chemistry I Lab I	
	Aesthetics Elective	3
	History Elective	3
		14

Spring Semester

35.252	Physiological Chem II	3
35.254	Physiological Chem II Lab	1
36.241	Clin Lab Theory & Physics	3
36.243	Clin Lab Techniques	1
36.341	Organic React & Struct	3
36.343	Organic React & Struct Lab	1
	Literature Elective	3
		15

Junior Year**Fall Semester**

36.321	Clinical Hematology	3
36.323	Clinical Hematology Lab	2
36.350	Human Biochemistry	3
36.361	Clinical Lab Instrumentation	3
36.363	Clinical Lab Instrument Lab	2
36.373	Clinical Lab Sci Seminar	1
		14

Spring Semester

36.311	Medical Bacteriology	3
36.313	Medical Bacteriology Lab	2
36.331	Clinical Immunology	3
36.351	Clinical Chemistry I	3
36.353	Clinical Chemistry I Lab	2
36.420	Clinical Hematology Practicum	2
		15

Senior Year**Fall Semester**

36.410	Clinical Micro Practicum	2
36.411	Med. Mycology and Parasitology	3
36.413	Med. Mycology and Parasitology Lab	2
36.431	Clinical Immunohematology	3
36.433	Clinical Immunohemat Lab	2
36.452	Clinical Chemistry II	3
36.454	Clinical Chemistry II Lab	2
36.473	Clinical Lab Sci Seminar	1
36.451	Clinical Urinalysis Practicum	0
		18

Spring Semester

36.415	Clinical Virology	1
36.430	Clinical Immunohem Pract	2
36.434	Advanced Topics in Hemostasis	1
36.436	Clinical Immunology/Serology Lab	1
36.450	Clinical Chem Pract	2
36.453	Laboratory Management & Ethics	2
36.474	Clinical Lab Sci Seminar	1
35.435	Medical and Clinical Genetics	3
		13

Total credits required 120

Clinical Sciences Option

By integrating their clinical and non-clinical experiences, graduates of the clinical sciences option are prepared for graduate studies and/or for industrial or government employment as research assistants, technical sales representatives, product development personnel, instrument designers, and/or technical service representatives. These students pursue a core of courses similar to students electing the medical technology option courses, but substitute additional didactic, laboratory and/or experiential opportunities. While this option is not structured to prepare graduates for certification as medical technologists, it does provide them with an opportunity to specialize in subject areas related to clinical laboratory science.

Course of Study for Clinical Laboratory Sciences**Clinical Sciences Option****Freshman Year****Fall Semester**

35.101	Human Anatomy & Physiology I	3
35.103	Human A & P I Lab	1
39.101	Physical Education	1
42.101	College Writing	3
47.101	General Psychology (Behav)	3
48.101	Intro to Sociology (Soc Sci)	3
92.183	Intro to Statistics	3
		17

Spring Semester

30.201	Community Health	3
35.102	Human Anatomy & Phys II	3
35.104	Human Anatomy & Phys II Lab	1
39.102	Physical Education	1
42.102	College Writing & Literature	3
92.125	Calculus A (Math) OR	
92.131	Calculus I for Chemistry Specialization	3
	Aesthetics Elective	3
		17

Sophomore Year**Fall Semester**

35.211	Basic Clin Micro & Pathology	3
35.213	Basic Clin Micro & Path Lab	1
35.251	Physiological Chemistry I*	3
35.253	Physiological Chemistry I Lab	1
95.103	General Physics I	3

96.103	General Experimental Physics I	1
	Literature Elective	3
		15

Spring Semester

35.252	Physiological Chemistry II*	3
35.254	Physiological Chemistry II Lab	1
36.341	Org React & Struct OR Organic Chem IB+IIB	3
36.343	Organic React & Struct Lab OR Organic Chem Lab IB+IIB	1
95.104	General Physics II	3
96.104	General Exper Physics II History Elective	1
		3
		15

Junior Year**Fall Semester**

36.321	Clinical Hematology	3
36.323	Clinical Hematology Lab	2
36.350	Human Biochemistry*	3
36.361	Clinical Lab Instrumentation	3
36.363	Clinical Lab Instrument Lab	2
		13

Spring Semester

36.311	Medical Bacteriology	3
36.313	Medical Bacteriology Lab	2
36.331	Clinical Immunology	3
36.351	Clinical Chemistry I	3
36.353	Clinical Chemistry I Lab	2
	Laboratory Sci Spec	3-5
		16-18

Senior Year**Fall Semester**

36.483	Senior Research	2
36.451	Clinical Chemistry II	3
36.454	Clinical Chemistry II Lab OR Directed Study	2-3
	Laboratory Sci Spec	3-5
	Laboratory Sci Spec	3-5
	Laboratory Sci Spec	3-5
		16-23

Spring Semester

36.484	Senior Research	2
35.435	Medical & Clinical Genetics	3
	Laboratory Sci Spec	3-5
	Laboratory Sci Spec	3-5
		11-15

*Or equivalent course (with departmental approval)

COLLEGE OF HEALTH PROFESSIONS*Department of Health and Clinical Sciences*

Students must select six laboratory science courses with the recommendation that a majority of courses be taken within an area of interest. These six must be approved courses only. Included as a laboratory sciences course is Directed Studies. The student must take a minimum of one directed study within their specialty and a maximum of two total.

Total credits required 120

Clinical Science Minor

Students interested in the Clinical Sciences Minor offered by the Department of Health and Clinical Sciences must first obtain the authorization of the Department and present 18 credits in the minor field with at least six credits at the upper division course level. The minor requires the following courses:

35.101	Human A & P I	3 cr
35.102	Human A & P II	3 cr
35.103	Human A & P Lab I	1 cr
35.104	Human A & P Lab II	1 cr
35.251	Physiological Chemistry I	3 cr
35.253	Physio. Chem. Lab I	1 cr

and 6 credit hours from among the following courses:

36.331	Clinical Immunology	3 cr
35.435	Medical & Clinical Genetics	3 cr
35.356	Pharmacology	3 cr
36.350	Human Biochemistry	3 cr
36.493	Directed Studies	3 cr

Nutrition Minor

Students interested in the Nutrition Minor offered by the Department of Health and Clinical Sciences must first obtain the authorization of the Department and present 21 credits in the minor field with at least six credits at the upper division course level. The minor requires the following courses:

35.101	Human A & P I	3 cr
35.102	Human A & P II	3 cr
35.103	Human A & P Lab I	1 cr
35.104	Human A & P Lab II	1 cr
35.251	Physiological Chemistry I	3 cr
35.253	Physio. Chem. Lab I	1 cr
30.206	Human Nutrition	3 cr

and 6 credit hours from among the following upper division courses:

36.350	Human Biochemistry	3 cr
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36.506	Biochemistry of Lipids	3 cr
36.563	Nutritional Biochemistry	3 cr
36.494	Dir Research in Nutrition	3 cr

**Clinical Laboratory Sciences
(Course Prefix: 35)****35.101 Human Anatomy & Physiology I**

This course provides a basic knowledge of the structure and function of the human body. An overview of the general organization of the body introduces the course. Following a discussion of basic human chemistry, the anatomy and physiology of cells, tissues, organs, and organ systems is studied with special emphasis placed on homeostasis and interaction among the various systems. The topics treated are body plan, chemistry, cytology, histology, the integumentary system, the skeletal system, the muscular system, the nervous system, and the endocrine system. Clinical applications are presented. Corequisite: 35.103. Bruce and Namm. 1(3,0)3

35.102 Human Anatomy & Physiology II

A continuation of the basic knowledge of human structure and function. The topics treated are cardiovascular system, lymphatic system, respiratory system, digestive system, metabolism, urinary system, and reproductive system. Prerequisites: 35.101, 35.103 (or equivalent). Corequisite: 35.104. Bruce, Hooker, and Namm. II(3,0)3

35.103 Human Anatomy & Physiology Laboratory I

Laboratory exercises are designed to reinforce didactic material by providing hands-on experience with the subject matter. Students actively participate in simple chemical analysis, microscopic observations, and studies of anatomical models and preserved specimens. Students perform simple physiological tests on themselves and work in small groups to discuss conclusions. Corequisite: 35.101. Members of the Department. I(0,3)1

35.104 Human Anatomy & Physiology Laboratory II

Laboratory exercises are designed to reinforce didactic material by providing hands-on experience with the subject matter. Students actively participate in simple chemical analysis, microscopic observations, and studies of anatomical models and preserved specimens. Students per-

form simple physiological tests on themselves and work in small groups to analyze results and discuss conclusions.

Prerequisite: 35.101, 103. Corequisite: 35.102. Members of the Department. II(0,3)1

35.211 Basic Clinical Microbiology & Pathology

This course is designed to study the fundamentals of microbiology with major emphasis on structure, function, growth, metabolism and classification of clinically important microorganisms. The human body's response to invading microbes and an introduction to the ecological aspects of microorganisms in the environment with particular stress on their significance, activities (beneficial and detrimental) and control measures will also be studied. Prerequisites: 35.102, 104. Corequisite: 35.213. Lam. I,II(3,0)3

35.213 Basic Clinical Microbiology & Pathology Laboratory

Laboratory investigations of basic properties and characteristics of microorganisms are conducted. Students will perform commonly used techniques for collecting, handling and studying clinically important microorganisms. Prerequisites: 35.102, 104. Corequisite: 35.211. Lam and Fessia. I,II(0,3)1

35.251 Physiological Chemistry I

This course provides a foundation in basic chemistry for students majoring in the Health Professions. Basic concepts covered include: properties of matter, energy, atomic and molecular structure, isotopes and radioactivity, chemical bonding, chemical formulae and reactions. Quantitative aspects of chemical processes, chemical equilibrium and the behavior of gases, including blood gases and their transport are discussed. Properties of water and solutions are studied and include units of concentration, osmosis, osmolality, and physiological fluid and electrolyte balance. The chemistry of acids, bases and buffers is reviewed with emphasis on physiological buffer systems. Quantitative aspects, acid/base balance, compensatory mechanisms and elementary diagnosis are discussed. The chemistry of inorganic trace elements and their physiological roles are investigated. Concepts of organic chemistry are introduced, including the structure and function of carbon, isomerism and the properties and selected reactions of the

major functional groups important in human biochemistry. Prerequisite: 35.102. Corequisite: 35.253. Frechette I(3,0)3

35.252 Physiological Chemistry II

This course is designed to provide a foundation in basic biochemistry for students majoring in the Health Professions. Selected concepts in organic chemistry are integrated into this framework. Aspects of amino acid and protein structure are studied. The structure and function of enzymes, their effects on reaction energetics and dynamics and the diagnostic uses of enzyme assays in clinical medicine are covered. The plasma proteins, hemoglobin, and the structure and function of miscellaneous cellular proteins are reviewed. The chemistry of the nucleic acids, protein anabolism and catabolism are studied along with selected metabolic disturbances and genetic disease. The structure and chemical properties of the simple and complex carbohydrates and lipids their metabolic pathways and cycles, and selected pathologies are studied in detail. Diagnostic tests relating to carbohydrate and lipid abnormalities are included. The course concludes with a study of chemical communication mechanisms, which includes neurotransmitters, hormonal secretions, and immunoglobulins. Prerequisite: 35.251. Corequisite: 35.254. Frechette. II(3,0)3

35.253 Physiological Chemistry I Laboratory

Laboratory experiments are conducted to complement the material covered in 35.251. Exercises dealing with properties of matter, chemical equations, qualitative analysis, energy, osmosis, chemical equilibrium and acids/bases/buffers will be performed. The qualitative properties of alcohols, aldehydes, ketones, acids and esters will be explored. Corequisite: 35.251. Members of the Department. I(0,3)3

35.254 Physiological Chemistry II Laboratory

Laboratory experiments are conducted to complement the material covered in 35.252. The chemistry of the basic biochemical molecules will be explored, including proteins, enzymes, carbohydrates, lipids, and nucleic acids. Selected aspects of metabolism and the assay of clinically significant materials will be studied. Prerequisite: 35.253. Corequisite: 35.252. Members of the Department. II(0,3)1

35.356 Pharmacology

An introduction to the chemistry, biochemistry and physiological actions of various pharmaceuticals. Fundamental concepts will be stressed and will include a discussion of drug receptors, drug receptor interactions, pharmacokinetics, enzyme induction, drug metabolism, drug safety and effectiveness and idiosyncratic reactions. Several major groups of drugs will be studied including: central nervous system stimulants, hypnotics, narcotic analgesics, anti-inflammatory drugs, cholinergics, adrenergics, adrenergic blocking drugs, antihypertensives, antihistamines, diuretics, adrenal steroids, anti-anemic drugs and antibiotics. Articles from the current literature will be discussed. Prerequisite: 35.252. Members of the Department. II(3,0)3

35.435 Medical & Clinical Genetics

This course is designed to introduce the pathological and clinical aspects of human genetics with emphasis on prevention, diagnosis, and treatment of genetic diseases. Mendelian, cellular, and molecular genetics are covered as well as the metabolic basis of inherited diseases. Students learn the principles of genetic counseling and how it integrates with other health care disciplines. Students apply genetic counseling precepts by analyzing a condition occurring in their own family and writing a term report that embodies the results of this research. Cytogenetic disorders, the genetics of cancer, somatic cell genetics, immunogenetics, and the "switching on and off" of genes will also be discussed. The application of laboratory techniques such as autoradiography and electrophoresis to DNA extraction, DNA fingerprinting, automated DNA sequencing, RFLP analysis, PCR amplification, and cloning methodology will be presented. Pre-implantation diagnosis, germ-line alteration, and embryo cloning will also be discussed, as will their legal, ethical, and moral implications. Current progress on the Human Genome Project will also be reported. Prerequisites: 35.102, 35.251, 35.253. Namm. II(3,0)3

Medical Technology and Clinical Sciences (Course Prefix: 36)

36.241 Clinical Laboratory Theory and Physics

This course is designed to introduce the theoretical principles and applications of diagnostic techniques and the procedures of the clinical laboratory. It will specifically review each specialty area, defining and describing both qualitative and quantitative, manual and automated laboratory techniques. Corequisite: 36.243. Members of the Department. II(3,0)3

36.243 Clinical Laboratory Techniques Laboratory

A laboratory course designed to expose prospective clinical scientists to many of the essential skills, methods, and procedures basic to professional performance in the clinical laboratory; to explain and demonstrate to students and have them perform these methods; to develop an understanding of these techniques and to provide a technical background, an approach to testing that the student can build upon and use in future courses. Prerequisite: 35.252. Corequisite: 36.241. Members of the Department. II(0,4)1

36.273 Introduction to Clinical Laboratory Sciences

A course designed to introduce students to aspects of the clinical sciences. Topics include the basic clinical laboratory, discussions, demonstrations, field trips, guest lecturers and selected readings. Doyle and members of the Department. II(0,2)2

36.311 Medical (Clinical) Bacteriology I

A study of the cultural, biochemical, genetic, serological and pathogenic characteristics of disease producing microorganisms. Emphasis will be placed on the pathophysiology of the infectious diseases and their relationship to isolation and identification of the pathogenic microorganisms. Prerequisites: 35.211, 35.213. Corequisite: 36.313. Fessia. II(3,0)3

36.313 Medical (Clinical) Bacteriology Laboratory I

This course is designed to introduce the student to pathogenic microorganisms, media and techniques used in the identification of these organisms. Emphasis will be based upon the isolation, identification and differentiation of pathogenic microor-

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Department of Health and Clinical Sciences

ganisms common to man. In addition, quality control and antimicrobial susceptibility testing will be covered. Corequisite: 36.311. Fessia, members of the Department. II(0,6)2

36.321 Clinical Hematology

A study of the human hematopoietic system and its relationship to other organ systems. Discussions will include morphological and biochemical relationships of erythropoiesis and leukopoiesis in health and disease states. A study of the mechanics of blood coagulation as it relates to health and disease states will also be included. Prerequisites: 35.102, 104, 35.252. Corequisite: 36.323. Hooker. I(3,0)3

36.323 Clinical Hematology Laboratory

This course is designed to emphasize current hematological and coagulation procedures used in today's clinical laboratory. The implications of these tests to diagnose, monitor and evaluate the various hematological disorders are also discussed. Corequisite: 36.321. Hooker and members of the Department. I(0,6)2

36.331 Clinical Immunology

An introduction to the principles of immunology including: the study of antigens and antibodies and their interactions and controls; description of cellular events and the immune response, and in vivo and in vitro antigen-antibody interactions with clinical relevance. Immunological aspects of transplantation, autoimmune disease, immunodeficiencies and cancer pathogenesis are also discussed. Prerequisite: 35.211, 35.213. Bruce. II(3,0)3

36.341 Organic Reactions and Structure

This course surveys the principles of organic chemistry important for the study of clinical chemistry and human biochemistry. The chemistry of carbon compounds, bonding and the concepts of isomerism will be studied. Detailed information is presented on each of the major functional classes of organic compounds, including: hydrocarbons, halides, alcohol, phenols, ethers, aldehydes, ketones, carboxylic acids and their derivatives, amines, organosulfur compounds. Emphasis is placed on chemical structure, physical and chemical properties, common and IUPAC nomenclature, and chemical reactions and their mechanisms. Selected aspects of the

properties and synthesis of polymeric materials are presented. Qualitative analysis of organic compounds is discussed with emphasis on the use of spectral techniques, including infra-red and nuclear magnetic resonance spectroscopy for the elucidation of chemical structure. Prerequisite: 35.251. Corequisite: 36.343. Frechette. II(3,0)3

36.343 Organic Reactions and Structure Laboratory

Laboratory exercises are performed to supplement the material covered in 36.341. Corequisite: 36.341. Frechette. II(0,3)1

36.350 Human Biochemistry

This course is an in-depth study of biochemical substances and their reactions in the body, with major emphasis placed on metabolism at the cellular level, and examined in the tissues of the various organs where these reactions occur. Correlation of biochemical processes underlying pathologic conditions will be made whenever practical. Prerequisite: 35.252, 35.254. Doyle. I(3,0)3

36.351 Clinical Chemistry I

This course is designed to introduce the clinical techniques of biochemical measurement in body fluids. These techniques range from general to specific assays and from the classical to the up-to-date state of the art methodologies. Biochemical measurements of the following in the normal state and alterations due to pathophysiology are discussed: amino acids, proteins, carbohydrates and lipids. Quality control of assay procedures is emphasized. Prerequisites: 36.341, 343, 36.350, 36.361, 36.363 or permission of instructor. Corequisite: 36.353. Rogers. II(3,0)3

36.352 Clinical Chemistry Laboratory I

This course is designed to introduce clinical laboratory procedures by studying the following compounds: carbohydrates, proteins, non-protein nitrogen compounds, porphyrins and lipids. Methods for troubleshooting, calibration and quality control will be emphasized. Prerequisite: 35.252 or permission of instructor. Corequisite: 36.351. Members of the Department. II(0,6)2

36.361 Clinical Laboratory Instrumentation

This course is designed to provide an in-depth knowledge of clinical chemistry laboratory instrumentation. Emphasis is

placed on theoretical concepts, instrument components and design, calibration and troubleshooting of modern instrumentation, and analytical methodologies in the clinical laboratory. Additionally, qualitative and quantitative applications of instrumental techniques are covered. Computer applications are included where appropriate. The following spectroscopic instruments are studied: ultraviolet, visible and infra red absorption, fluorescence, turbidimetry and nephelometry, reflectance, flame emission and atomic absorption spectroscopy. Electrochemical methods of analysis are reviewed, including potentiometric techniques, voltammetry and coulometry. Chromatographic instrumentation and methods are discussed, such as column and thin layer chromatography, high pressure liquid chromatography, gas chromatography, and ion exchange chromatography. Prerequisite: 36.241 or 95.103. Corequisite: 36.363. Frechette. I(3,0)3

36.363 Clinical Laboratory Instrumentation Lab

Laboratory exercises will be performed to supplement the material covered in 36.361. Corequisite: 36.361. Frechette. I(0,4)2

36.373 Clinical Laboratory Sciences Seminar

This course is designed to familiarize students with government regulations (including CDC & OSHA) concerning the clinical laboratory. Students also will gain computer experience in word processing, data base spreadsheet functions and their application in the clinical lab. Finally, students learn how to write a scientific research paper and to make a public presentation. Fessia. I(1,0)1

36.506 Biochemistry of Lipids

This advanced course in the nutritional biochemistry and physiology of lipids will detail the role of lipids in the normal and pathological processes at both the cellular and whole organism level. Topics will range from general discussions of the digestion, absorption and transport of lipids to the role of eicosanoids and lipid soluble anti-oxidants during normal and diseased states, such as atherosclerosis, diabetes and hypertension. Subject matter will also include a discussion of the various interventions for the prevention and treatment of certain of these disease states. There will also be discussion of the current issues in lipid nutrition. Prerequisite: 36.350. Nicolosi. II(3,0)3

*Department of Health and Clinical Sciences***36.410 Clinical Microbiology Practicum**

Supervised clinical training in an affiliated clinical laboratory, designed to reinforce knowledge and skills gained in lecture and laboratory and at the same time introduce the student to the daily activities of the clinical microbiology laboratory. Emphasis will be placed on quality control, methodology and clinical interpretation. Prerequisites: 36.311, 36.313. Doyle and members of the department. I(0,8)2

36.411 Medical Mycology and Parasitology

Intensive study of classification, morphology, physiology, genetics and ecology of medically important fungi and parasites. Emphasis on epidemiology, pathogenicity and diagnosis. Prerequisites: 36.311, 36.313. Corequisite: 36.413. Fessia. I(3,0)3

36.413 Medical Mycology and Parasitology Laboratory

The laboratory is designed to emphasize principles and procedures used in the isolation, cultivation, and identification of medically important fungi and parasites. Corequisite: 36.411. Fessia, members of the department. I(0,4)2

36.415 Clinical Virology

This course is designed to survey pathogenic viruses emphasizing diagnosis of disease. Evaluation of new technology and diagnostic tests with reference to diagnosis and prognosis of disease are examined. Fessia. II(1,0)1

36.420 Clinical Hematology Practicum

Supervised clinical training in an affiliated clinical laboratory. Designed to reinforce knowledge and skills gained in lecture and laboratory and at the same time introduce the student to the daily activities of a clinical hematology laboratory. Emphasis will be placed on quality control, methodology, and clinical interpretation. Prerequisites: 36.321, 36.323. Doyle, members of the Department. II(0,6)2

36.430 Clinical Immunohematology Practicum

Supervised clinical training in an affiliated clinical laboratory is designed to reinforce knowledge and skills gained in lecture and laboratory and, at the same time, introduce the student to the daily activities of the clinical immunohematology laboratory. Emphasis will be placed on quality

control, methodology and clinical interpretation. Prerequisites: 36.331, 431, 433. Doyle, members of the Department. II(0,6)2

36.431 Clinical Immunohematology

Lecture and case study discussions look at the major red cell antigen systems which are of importance in understanding transfusion therapies, compatibility testing, and pathological diseases. Emphasis is on differentiation and clinical significance of each system. Donor selection regulations, component preparation, and hemotherapy will also be discussed. Prerequisites: 36.331. Corequisite: 36.433. Doyle. I(3,0)3

36.433 Clinical Immunohematology Laboratory

Practical laboratory experience in blood banking, illustrating the concepts stressed in the lecture. Prerequisite: 36.331. Corequisite: 36.431. Doyle, members of the department. I(0,4)2

36.434 Advanced Topics in Hemostasis

This course will constitute an in depth study of the hemostatic mechanism. Current research and case studies on the roles of vessel endothelium, platelet function, clotting procoagulants and fibrinolysis will be presented. Students will diagnose pathologic hemostatic states, such as hemorrhage or thrombophilia, due to deficiencies and impairments of these roles, including the impact of natural and acquired anticoagulants/inhibitors and anticoagulant therapy. Prerequisites: 36.321, 36.323. Hooker II(1,0)1

36.436 Clinical Immunology/Serology Laboratory

This laboratory is designed to instruct students in the principles and techniques used in the clinical immunology setting. Students will become proficient in laboratory techniques such as immunodiffusion, ELISA, hemagglutination, neutralization and tissue culture techniques used for immunodiagnosis. Prerequisite: 36.331. Mehta II(0,3)1

36.450 Clinical Chemistry Practicum

Supervised clinical training in an affiliated hospital clinical laboratory. Designed to reinforce knowledge and skills gained in lecture and laboratory and at the same time introduce the student to the daily activities of the clinical laboratory. Emphasis will be placed on quality con-

trol, methodology and clinical interpretation. Prerequisites: 36.452. Doyle, members of the department. II(0,6)2

36.451 Urinalysis Practicum

A one week clinical rotation in an affiliated laboratory designed to give the student experience in microscopic examination and evaluation of urine sediments. Emphasis is on correlating physical and chemical characteristics with sediment evaluation and diagnoses. Additional routine tests of a physical and chemical nature will be performed and demonstrated. Prerequisites: 36.452, 454. Doyle, members of the Department. II(0,1)0

36.452 Clinical Chemistry II

This course is designed to introduce clinical techniques of biochemical measurement in body fluids. These techniques range from general to specific assays and from the classical to the up-to-date state of the art methodologies. Biochemical measurements of the following in the normal state: urinalysis, blood gases, acid-base balance, electrolytes, osmolality, hemoglobin, toxicology, therapeutic drug monitoring, and endocrinology, as well as alterations due to pathophysiology, are discussed. Quality control of assay procedures is emphasized. Prerequisite: 36.351. Corequisite: 36.454. Rogers. I(3,0)3

36.453 Laboratory Management and Ethics

This course will acquaint the student with the many managerial, educational, technical, and administrative theories and practices, as well as moral and ethical issues that may confront the health care professional functioning within a clinical or research laboratory setting. In addition, it will present the varied career opportunities that are available for graduates. Hooker. II(2,0)2

36.454 Clinical Chemistry Laboratory II

This course, a continuation of 36.353, is designed to instruct the student in the analytical procedures and methods currently used in the clinical laboratory. Manual and automated methods utilized in the assessment of such topics as acid-base balance, porphyrins, toxicology and vitamins will be introduced. In addition, methods associated with the routine examinations of urine will be introduced. Quality control, laboratory safety and professional performance are emphasized. Prerequisite: 36.351, 36.353. Corequisite: 36.452. Members of the department. I(0,6)2

COLLEGE OF HEALTH PROFESSIONS

Department of Physical Therapy

36.473 Clinical Laboratory Sciences Seminar

This course is designed to familiarize the student with different interview skills and approaches to resume writing, computer expert system usage in the clinical laboratory, and the tools required to be a good educator. Members of the Department. I(1,0)1

36.474 Clinical Laboratory Sciences Seminar

This course is designed to familiarize the student with different types of questions used in the national certification exams and to give the student the opportunity to write and present clinical case studies correlating the laboratory testing with the diagnosis and treatment of the patient. Also the student will be given hands on experience with the personal computer. Members of the Department. II(1,0)1

36.483 Senior Research

Students along with their faculty advisor will structure a research project commensurate with the students' areas of interest. A paper embodying the results of the research project will be prepared. Members of the Department. I(0,6)2

36.484 Senior Research

Continuation of 36.483. Members of the Department. II(0,6)2

36.493 Directed Studies

Students along with their faculty advisor will structure an acceptable project in one of four areas: research, program development, teaching, or clinical practicum. Students are eligible to earn three credits in accordance with departmental policy. Members of the Department. I,II(0,6)3

36.494 Directed Research in Nutrition

Students with their faculty advisor structure a research project in the area of nutrition. A paper embodying the results of project will be prepared. Members of the Department. I,II(0,6)3

Department of Physical Therapy

Joseph A. Dorsey, Chairperson

Professors: Barbara Cocanour, Linda Kahn-D'Angelo, Joseph Dorsey

Associate Professors: Claire Chamberlain, Susan O'Sullivan, Joyce White

Assistant Professors: Connie Seymour, Gerry Dybel, Brian Don

Academic Coordinators Clinical Education

Physical Therapy, Lisa Falvo

Exercise Physiology, Claire Chamberlain

Exercise Physiology Major

The Department of Physical Therapy of the College of Health Professions at the University of Massachusetts Lowell offers a major in Exercise Physiology which focuses on the general and specific physiological effects of exercise on the human systems. The curriculum combines liberal arts courses, basic sciences, professional courses, and clinical practice.

Graduates of the Exercise Physiology Option are prepared for employment as practitioners, researchers, and teachers in many growing fields. Hospitals, rehabilitation centers, fitness centers, private physicians' offices, and various types of cardiac rehabilitation centers employ exercise physiologists to run programs. Graduates are also qualified for employment in worksite fitness programs, health spas, and sports centers. Students in the Exercise Physiology Major who qualify academically will be prepared to pursue graduate entry level programs in Physical Therapy.

Exercise Physiology Major Course of Study

For students entering 1993 and later

Freshman Year**Fall Semester**

35.101	Human A & P I	3
35.103	Human A & P Lab I	1
42.101	College Writing I	3
47.101	General Psychology	3
92.183	Intro to Statistics	3
	History Elective	3

16

Spring Semester

35.102	Human A & P II	3
35.104	Human A & P Lab II	1
42.102	College Writing II	3
48.101	Intro to Sociology	3
47.260	Human Development I	3
	Elective	3

16

Sophomore Year**Fall Semester**

35.251	Physiological Chemistry I	3
35.253	Physiological Chemistry Lab II	1
95.103	General Physics I	3
96.103	General Exp Physics I	1
30.206	Human Nutrition	3
	Literature Elective	3

14

Spring Semester

35.252	Physiological Chemistry II	3
35.254	Physiological Chemistry Lab II	1
95.104	General Physics II	3
96.104	General Exp Physics II	1
38.202	Intro to EP	3
30.201	Community Health	3
	Elective	3

17

Junior Year**Fall Semester**

38.305	Exercise Physiology I	4
38.307	Exercise Physiology Lab I	1
47.328	Dynamics of Interpersonal Rel	3
38.315	Kinesiology and Lab	4
36.350	Human Biochemistry	3

15

Spring Semester

38.406	Exercise Physiology II	4
38.408	Exercise Physiology Lab II	1
30.306	Intro to Gerontology	3
47.272	Abnormal Psychology	3
	Aesthetics Elective	3

14

Senior Year**Fall Semester**

35.356	Pharmacology	3
38.412	Clinical Pract (1/2 the class)	4
38.418	Seminar	3
38.417	Research Methods in E P	3
38.422	Exercise Prescript & Prog	3

16

Department of Physical Therapy

Spring Semester

31.407	Health Care Systems	3
38.420	Indep Study in EP	3
	Elective (values)	3
	Elective	3
		12

or

Fall Semester

35.356	Pharmacology	3
31.407	Health Care Systems	3
38.417	Research Methods in EP	3
38.422	Exercise Prescript & Prog	3
		12

Spring Semester

38.418	Seminar	3
38.412	Clinical Prac (1/2 the class)	4
38.420	Independent Study in EP	3
	Elective (values)	3
	Elective	3
		16

**Exercise Physiology
(Course Prefix: 38)****38.202 Introduction to Exercise Physiology**

Introduces students to the major in exercise physiology. Objectives of the major are covered along with present and future uses of exercise physiology. Guest speakers are used to enhance the students knowledge regarding the profession. II(3,0)3

38.305 Exercise Physiology I

This first course of a two course sequence will examine the effects on the skeletal, muscular, neurological and integumentary systems. The lecture portion of this course will introduce the students to understanding the concepts of physiological and metabolic functioning of the human body during physical activity. Students taking this course are advised that the capability to exercise moderately and maximally will be necessary. Prerequisite: 38.202. Corequisite: 38.307. I(4,0)4

38.307 Exercise Physiology I Lab

This course must be taken concurrently with 38.305. It offers students the opportunity to test and evaluate physiological concepts and skills discussed in the lecture. Student physical examinations completed prior to each academic year should include cardiopulmonary status indicating

exercise capability. Documentation must be provided to the Department prior to entering this laboratory course. Prerequisite: 38.202. Corequisite: 38.305. I(0,3)1

38.315 Kinesiology and Lab

Focuses on a process of examining the anatomical and mechanical concepts required for critical assessment, description, and qualitative analysis of human motion. The laboratory portion of the course introduces the student to the techniques used to analyze human motion. Prerequisite: successful completion of all first and second year exercise physiology courses. I(3,1)4

38.406 Exercise Physiology II

This course, the continuation of Exercise Physiology I, deals with the physiological and metabolic functioning of the human systems during physical activity. This portion of the sequence deals with the cardiorespiratory, urogenital, digestive and endocrine systems. Prerequisites: 38.305, 38.307. Corequisite: 38.408. II(4,0)4

38.408 Exercise Physiology II Lab

This course is designed to provide the student with hands on experience in a variety of laboratory techniques that can be utilized in calculating and assessing the neurological, cardiorespiratory, urogenital and endocrine systems. Prerequisites: 38.305, 38.307. Corequisite: 38.406. II(0,3)1

38.412 Clinical Practicum I & II

This course is an off-campus experience in either a cardiac/rehab pulmonary clinical facility or corporate fitness setting. Students experience practical applications of those concepts and theories learned in the classroom settings. Students are provided a seminar atmosphere on their return to the campus to discuss current research and literature relative to experiences they have had while on clinical. Prerequisite: All 1st, 2nd and 3rd year Ex. Phys course work. Corequisite: 38.418. I,II(0,12)4

38.417 Research Methods in Exercise Physiology

The lecture content involves an in-depth study of current research methods and research topics with specific applications to the field of exercise physiology. The content will examine the sources of data acquisition, sampling, instrumentation or testing devices, research design, testing

procedures, and treatment of data. Each student must participate in a senior research project utilizing information gained from the lecture portion of this class. Prerequisite: All 1st, 2nd and 3rd year Ex. Phys course work. II(4,0)3

38.418 Seminar in Exercise Physiology

This course is specifically designed to enhance the practicum experiences of Exercise Physiology students in their senior year. Corequisite: 38.412 I, II (3,0)3

38.420 Independent Study in Exercise Physiology

This course is the capstone course in Exercise Physiology. Students summarize and synthesize the teachings and experiences in Exercise Physiology into one culminating, progressive and descriptive project. Prerequisite: All 1st, 2nd and 3rd year Ex. Phys course work. II(3,0)3

38.422 Exercise Prescription & Programming

This course is an essential foundation of the conceptual approach to exercise prescription and programming, applying physiological, organizational, and educational principles in the practical setting. Factors which impede or enhance exercise compliance and progress will be explored. Clinical teaching skills, safety, and professional behavior will be underscored. Prerequisite: All 1st, 2nd and 3rd year Ex. Phys course work. I(3,0)3

COLLEGE OF HEALTH PROFESSIONS*Department of Nursing***Department of Nursing**

May Futrell, Chair

Professors: Nina Coppens, Cheryl Cox, May Futrell, Lee Ann Hoff Karen Melillo, Janice Stecchi

Associate Professors: Janet Douglass, Susan Reece, Eileen Williamson

Assistant Professors: Joan Ashlock, Sharon George, Mary Ann Kelly, Pauline Ladebauche, Barbara Mawn, Arlene McGrory, Carole Pearce, Sheila Perrault, Lisa Plante-McCurley, Laurel Radwin, Deborah Sigman

Instructors: Jan Leonard, Joyce Wells

Director, Nursing Laboratories: Hermine Cleary

Nursing Major

The nursing program prepares a professional nurse who is a competent, beginning practitioner and has a foundation for graduate study. The goal of the undergraduate program in nursing at the University of Massachusetts Lowell is to prepare professional nurses who have the ability to think logically, to utilize knowledge of relevant theories, and to apply the nursing process when caring for clients of all ages in a variety of settings.

Graduates of the nursing program are prepared to function in a variety of health care settings such as hospitals, long term care facilities and nursing homes, visiting nurse associations, clients' homes, community and mental health agencies, and work environments. Graduates are eligible to sit for the Board of Registration in Nursing's NCLEX examination for licensure as a registered nurse.

The nursing program is approved by the Massachusetts Board of Registration in Nursing and is fully accredited by the National League for Nursing.

Philosophy

The philosophy of the Department of Nursing reflects beliefs regarding person, environment, health and nursing. People have unique, individual qualities and basic needs for respect, worth, and recognition of personal dignity. They have the right to make choices and establish goals which influence and are influenced by the environment. Health is a dynamic state of

physiological, psychological, social and spiritual well being. Nursing is a health care discipline which uses the nursing process to support individuals, families, groups and communities in the promotion of health throughout the life span.

Education is a self-actualizing, creative, lifetime endeavor involving values clarification, progressive systematic inquiry, critical analysis and judgment. The baccalaureate nursing program incorporates a liberal education with generalized preparation in professional nursing. The masters program is predicated upon a baccalaureate nursing education and prepares individuals as specialists. The doctoral program is predicated upon specialization at the master's level and prepares nurse leaders in health promotion.

Upon successful completion of the University of Massachusetts Lowell undergraduate program in nursing, graduates are prepared as a generalist for beginning professional nursing roles. Specifically, the faculty believes that the graduates are prepared to:

1. demonstrate, through relationships with others, recognition of intrinsic worth, responsibilities, and rights of self and others;
2. establish, maintain, and terminate therapeutic relationships with individuals, families and groups;
3. utilize the nursing process to make critical judgments when caring for people of all ages and developmental stages in a variety of settings;
4. integrate relevant principles and theories from nursing, the behavioral sciences, natural sciences, and the humanities into the practice of professional nursing;
5. contribute to the optimal health of clients, by providing safe, competent, professional nursing care independently and in collaboration with others;
6. integrate teaching/learning concepts into nursing practice for health promotion;
7. assume leadership responsibilities to effect change for the improvement of nursing care;
8. identify the significance of the historical perspective of the profession of nursing and the relationship to contemporary and future nursing roles;

9. contribute to the expanding body of nursing knowledge through application of research findings; and

10. accept responsibility for continuous growth as a person, a professional practitioner, and a contributing citizen.

Clinical Laboratory Placements

Courses in the nursing major are offered within the Department of Nursing and are under the direct control and supervision of the nursing faculty. The clinical aspects of the nursing program are developed, coordinated, and supervised by the nursing faculty and are provided in collaboration with members of the utilized community agencies. Placements include: Beth Israel Hospital, Edith Nourse Rogers Memorial Veterans Hospital, Greater Lawrence Family Health Service, Lawrence General Hospital, Lowell General Hospital, local nursery schools, University of Massachusetts Medical Center, VNA of Greater Lowell, Massachusetts General Hospital, Boston Children's Hospital, Massachusetts Eye and Ear Infirmary, Tewksbury Hospital, Homecare Inc. of Andover, Saints Memorial Medical Center, Sunny Acres Nursing Home, Woodbriar of Wilmington, Palm Manor, Westford Nursing Home and other community based health care providers.

Additional agencies are utilized when necessary to enhance student learning. Clinical placement of students is at the discretion of the supervising faculty. Students are expected to provide transportation to clinical experiences.

Required Uniforms

To participate in the practicum portion of the curriculum, students are required to purchase an official white uniform with insignia, appropriate shoes, a name pin, bandage scissors, and a watch with a second hand. Students not meeting the uniform policies as stated at the beginning of the clinical experience will be asked to leave the clinical agency and will have to make up lost time. Student uniform does not include extra jewelry, ankle socks, bright colored sweaters, sneakers or clogs. The official uniform and extra school insignias are obtained from McGill's, Inc., Manchester, NH. A company representa-

Department of Nursing

tive comes to campus and orders are taken during the spring semester of the sophomore year for availability for the first clinical experience in the fall of the junior year. Registered nurse students may wear their own uniforms but must attach a University of Massachusetts Lowell insignia to this uniform while in the clinical area for student experiences. Students must present themselves in a professional manner in any clinical setting and in accordance with the agency policies where they are assigned.

Transfer Policies for Registered Nurses

The Department of Nursing is committed to encouraging registered nurses who possess a diploma or an associate degree to return for further study leading to a baccalaureate degree with a major in nursing.

Application for admission to the full-time day program of the University is made through the Admissions Office.

Acceptance of credit for transfer courses is determined by the Chairperson of the Department, once official transcripts have been received. Several articulation agreements have been signed with associate degree programs in nursing. Course descriptions may be requested by the appropriate department chairperson to determine if courses meet specific curriculum requirements. Completed transfer of credit forms become a part of the students' transcripts. Part time study for prerequisite and elective courses is available to registered nurses through the day school, continuing education, the Encore Program and summer school. Faculty are available to advise prospective students upon request. Registered nurses entering the Department through the Encore Program or through transfer admissions must meet the same requirements as other students, namely a 2.5 overall cumulative average and a 2.5 science cumulative average. A photocopy of current nursing license, current CPR certification and insurance coverage must be submitted to the Department, and a record of continuous coverage for both documents must be provided according to expiration dates.

Registered nurses are encouraged to utilize the opportunity to gain credit for previous learning through CLEP or equivalency examinations. All students must take 33.207 Concepts of Baccalaureate Nursing. Registered Nurse students may accelerate through the basic skills and/or

physical assessment laboratories of the sophomore year by demonstrating proficiency in these nursing areas.

Registered Nurses who are graduates of diploma and associate nursing programs may be awarded advanced standing through a combination of transcript evaluation, course equivalency procedures, National League of Nursing mobility examinations and/or articulation agreements.

42.101	College Writing I
42.102	College Writing II
84.111	Gen Chem I*
84.112	Gen Chem II*
84.113	Gen Chem Lab I*
84.114	Gen Chem Lab II*
35.101	A & P I*
35.102	A & P II
35.103	A & P Lab I*
35.104	A & P Lab II
35.211	Microbiology*
35.213	Microbiology Lab*
92.183	Intro to Statistics
47.101	General Psychology
47.260	Human Develop I
47.232	Psych of Personality
30.201	Community Health
48.101	Intro to Sociology and
30.306	Intro to Gerontology or
47.360	Human Development II

*Must achieve a cum of 2.500 in the combination of courses

The following course is a prerequisite for the senior nursing courses.

47.328 Dynamics of Interpersonal Relationships

Registered nurse students follow the same program of studies as all other students in the Department and must meet the same academic criteria for retention and graduation. Registered nurse students may negotiate for alternative clinical experiences during the senior year. Requests for alternative experiences and objectives to be accomplished must be made in writing and planned with the faculty member during the semester prior to the experience so that adequate arrangements can be made with the appropriate clinical facilities. Individual faculty and teaching teams will make final decisions on the educational merit and feasibility of each request.

Retention, Continuance, Grading Policies, and Appeals Procedure

To qualify for continued matriculation in the nursing program, all students must meet the academic criteria as specified in the retention and continuance policies for the College of Health Professions.

All nursing students' coursework will be reviewed for an overall cumulative average of 2.5 and a science cumulative average of 2.500 before entering the first semester of the sophomore year regardless of the number of credits earned at the University of Massachusetts Lowell at that point.

In addition, the clinical portions of nursing courses are graded on a 'S' (satisfactory) or 'U' (unsatisfactory) basis. A grade of 'S' indicates that students have satisfactorily completed the course objectives for the clinical experience. Irrespective of their individual achievement in non-clinical course components, students who receive an unsatisfactory clinical evaluation in a nursing course shall earn a final course grade of 'F' (failure) and their enrollment shall be terminated immediately.

Students who have been denied continuance in the nursing major for academic reasons or students who have been dismissed from the program for non-academic reasons may appeal for reinstatement. The appeal procedure for reinstatement is outlined in the policies of the College of Health Professions.

Withdrawal

Students who wish to withdraw from any nursing course are advised that such withdrawal requires simultaneous withdrawal from all nursing courses and possible termination of enrollment in the nursing program.

Withdrawal from any of the seven week clinical courses must be done by the beginning of the fourth week of that course.

Such students who wish to apply for readmission to the nursing program as members of subsequent graduation classes are advised that consideration for readmission is determined not only by academic eligibility requirements in effect for the class to which admission is sought but also by

COLLEGE OF HEALTH PROFESSIONS

Department of Nursing

enrollment quotas. Accordingly, students are advised to confer with the Chairperson of the Department of Nursing prior to applying for readmission in order to ascertain if program vacancies exist.

DEPARTMENT OF NURSING (Class Entering 1996 and Following)

FRESHMAN YEAR

Fall Semester

42-101	College Writing I	3
47-101	General Psychology	3
35-101	Human A & P I	3
35-103	Human A & P I Lab	1
48-101	Intro to Sociology	3
TOTAL		13

Spring Semester

42-102	College Writing II	3
47-260	Human Develop I	3
35-102	Human A & P II	3
35-104	Human A & P II Lab	1
	Elective (Aesth)	3
	Elective (Lit)	3
TOTAL		16

SOPHOMORE YEAR

Fall Semester

35-251	Physiol Chem I	3
35-253	Physiol Chem I Lab	1
	OR	
84-111	General Chemistry I	3
84-113	General Chem. I Lab	1
35-211	Basic Microbiology	3
35-213	Basic Microbiology Lab	1
30-201	Community Health	3
	Elective (history)	3
TOTAL		14

Spring Semester

35-252	Physiol Chem II	3
35-254	Physiol Chem II Lab	1
	OR	
84-112	General Chemistry I	3
84-114	General Chem II Lab	1
30-206	Human Nutrition	3
30-306	Intro to Gerontology	3
92-283	Stat for Behav. Sci	3
	Elective (values)	3
TOTAL		16

JUNIOR YEAR

Fall Semester

33-310	Health Promotion & Risk Reduction of Families I	4
33-311	Health Promotion & Risk Reduction of Families Prct. I	3
33-312	Concepts of Prof. Nsg. Prct	3
33-313	Nsg. Assessment & Skills	3
33-301	Research & Health Care	3
TOTAL		16

Spring Semester

33-314	Health Promotion & Risk Reduction of Families II	5
33-315	Health Promotion & Risk Reduction of Families Prct. I	4
33-316	Family Seminar	2
33-317	Pathopharmacology	5
TOTAL		16

SENIOR YEAR

Fall Semester

33-410	Nsg. Care of Clients with acute & life threatening illnesses	5
33-411	Nsg. Care of Clients with acute & life threatening illnesses prct.	4
33-412	Comm. Health & Health Policy	4
TOTAL		13

Spring Semester

33-413	Role Transition	4
33-414	Role Practicum	6
	Elective (free)	3
33-415	Comm. Health Project	3
TOTAL		16

Nursing (Course Prefix: 33)

These courses apply to students entering the nursing major as freshmen in 1996. Course titles and descriptions are subject to change.

33.301 Research and Health Care

This course focuses on the research process, examples of knowledge derived from health research, and the application of this knowledge. Health care research interests and methodology of various disciplines are examined. This course can be taken prior to but no later than the fifth semester. Pre-requisite 92.283 Statistics for the Behavioral Sciences or equivalent. Members of the Department. I(3,0)3

33.310 Health Promotion and Risk Reduction of Families I

This course focuses on health promotion and risk reduction with individuals and young families who are responding to potential or actual physical and psychosocial health problems. Content is centered on holistic nursing care from a lifespan perspective beginning in pregnancy and ending with adolescence. Prerequisite: first four semesters of nursing curriculum. Corequisites: 33.301, 33.311, 33.312, 33.313. Members of the Department. I(4,0)4

33.311 Health Promotion and Risk Reduction of Families I, Practicum

This community-based clinical course is focused on health promotion of young families including childbearing women, infants, children, and adolescents. A portion of the clinical experience consists of the initiation of a long term relationship by the student with a family. Prerequisite: first four semesters of nursing curriculum. Corequisites: 33.301, 33.310, 33.312, 33.313. Members of the Department. I(0,9)3

33.312 Concepts of Professional Nursing

Practice Nursing as a health profession is introduced in this foundation course. The concepts of health promotion, communication, critical thinking, culture, nursing theory and research, and therapeutic nursing interventions are presented. Within the context of the American Nurses' Association Standards of Clinical Nursing Practice, standards of professional performance are introduced and standards of care are emphasized. Prerequisite: first four semesters of nursing curriculum. Corequisites: 33.301, 33.310, 33.311, 33.313. Members of the Department. I(3,0)3

33.313 Nursing Assessment and Skills

This clinical laboratory course introduces students to the foundations of communication and health assessment as applied to the Standards of Clinical Nursing Practice. Emphasis is placed on the integration and application of these skills through the use of critical thinking. Prerequisite: first four semesters of nursing curriculum. Corequisites: 33.301, 33.310, 33.311, 33.312. Members of the Department. I(2,3)3

Department of Nursing

33.314 Health Promotion and Risk Reduction of Families II

This course focuses on health promotion and risk reduction with adults and their families who are responding to potential or actual physical and psychosocial health problems. Content is centered on holistic nursing care throughout the adult lifespan. Prerequisites: 33.301, 33.310, 33.311, 33.312, 33.313. Corequisites: 33.315, 33.316, 33.317. Members of the Department. II(5,0)5

33.315 Health Promotion and Risk Reduction of Families II, Practicum

In this clinical course, students provide nursing care to adult clients and their families. The focus is the development of specifically tailored therapeutic interventions to promote the health of these clients and assist with potential or actual health problems. Corequisites: 33.314, 33.316, 33.317. Members of the Department. II(0,12)4

33.316 Family Seminar

This seminar provides the opportunity for students to continue their in-depth health care experiences with families. Students apply principles of health promotion in the care of a well family. Characteristics of diverse families are compared and contrasted. Corequisites: 33.314, 33.315, 33.317. Members of the Department. II(2,0)2

33.317 Pathopharmacology

This course focuses on nursing implications of human pathophysiology and related pharmacological interventions for major health problems across the lifespan. Content includes a conceptual approach to physiologic responses, clinical presentation, and pharmacological management. Corequisites: 33.314, 33.315, 33.316. Members of the Department. II(5,0)5

33.410 Clients with Acute and Life Threatening Illnesses Across the Lifespan

This course addresses the nursing care of individuals with common acute and life threatening illnesses across the lifespan. Particular attention is paid to nursing care of clients with increasing complexity and acuity levels. Prerequisites: 33.314, 33.315, 33.316, 33.317. Corequisites: 33.411, 33.412. Members of the Department. I(5,0)5

33.411 Clients with Acute and Life Threatening Illnesses Across the Lifespan, Practicum

In this clinical course, students provide nursing care to individuals with common acute and life threatening illnesses. The focus is the development of specifically tailored therapeutic interventions in providing care to clients across the lifespan. Corequisites: 33.410, 33.412. Members of the Department. I(0,12)4

33.412 Community Health and Health Policy

This course analyzes the development of policy and its impact on the health of populations. Students apply epidemiology and community health science to population-based nursing practice. Corequisites: 33.410, 33.411. Members of the Department. I(4,0)4

33.413 Role Transition

This capstone course focuses on the transition to the professional nursing role. Content includes professional issues, trends, and leadership and management principles which impact on nursing practice. Students analyze nursing practice in relation to the standards of professional performance. Prerequisites: 33.410, 33.411, 33.412. Corequisites: 33.414, 33.415. Members of the Department. II(4,0)4

33.414 Role Transition, Practicum

During this clinical experience, students work collaboratively with nurse preceptors and other members of the health care team. Students become increasingly self-directed in carrying out the professional nursing role. Corequisites: 33.413, 33.415. Members of the Department. II(0,18)6

33.415 Community Health Project

The student applies the American Nurses' Association Standards of Community Health Nursing Practice with community as client. The project involves a community assessment and participation in the development, implementation, and/or evaluation of a community health intervention. Corequisites: 33.413, 33.414. Members of the Department. II(3,0)3

Faculty of the College of Health Professions

Janice M. Stecchi, R.N., B.S., M.Ed., M.S., Ed.D., Dean

Department Chairpersons

Joseph A. Dorsey, B.S., M.S., C.A.G.S., Ed.D., Physical Therapy

May Futrell, R.N., B.S., A.M., Ph.D., Nursing

Beverly J. Volicer, B.A., M.A., M.P.H., Ph.D., Health and Clinical Sciences

Resident Faculty

Joan Ashlock, Assistant Professor, Nursing; R.N., B.S.N., University of Missouri; M.S.N., St. Louis University.

Alease Bruce, Professor, Health and Clinical Sciences; B.S., Hampton University; Ph.D., Howard University.

Claire Chamberlain, Associate Professor, Exercise Physiology; B.S. Ed., Ed.M., Tufts University; C.A.G.S., Northeastern University.

Nicole Champagne, Instructor, Health and Clinical Sciences; B.S., Stonehill College; M.Ed., Bridgewater State College

Barbara A. Cocanour, Professor, Physical Therapy; A.B., Defiance College; M.S., Ph.D., University of Maine.

Nina Coppens, Professor, Nursing; R.N., B.S., M.S., Northern Illinois University; M.A., Ph.D., University of New Hampshire.

Cheryl Cox, Professor, Nursing; R.N., B.S., University of Tennessee; M.S., Vanderbilt University; Ph.D., University of Rochester; Certificate in Business Administration, University of Illinois.

Brian Don, Assistant Professor, Exercise Physiology; B.S., Brighton University (U.K.); M.S. Boston University; Ed.D., Boston University.

Joseph A. Dorsey, Professor, Physical Therapy; R.P.T., B.S., Springfield College; M.Ed., Northeastern University; C.A.G.S., New York University; Ed.D., Boston University.

Janet Douglass, Associate Professor, Nursing; R.N., B.S.N., St. Anselm College; M.S., Boston College; D.N.Sc., Boston University.

COLLEGE OF HEALTH PROFESSIONS*Faculty*

Kathleen M. Doyle, Professor, Health and Clinical Sciences; M.T. (ASCP), B.S., University of Massachusetts Amherst; M.S., Ph.D., University of Lowell.

Gerard Dybel, Assistant Professor, Physical Therapy; B.S., Indiana University; M.Ed., University of Toledo; M.S., The U.S. Army/Baylor University.

Sandra L. Fessia, Professor, Health and Clinical Sciences; B.A., University of Texas; M.S., Ph.D., Wayne State Medical School.

Michael Frechette, Associate Professor, Health and Clinical Sciences; B.S., Merrimack College; Ph.D., University of Rhode Island.

May Futrell, Professor, Nursing; R.N., B.S., A.M., Columbia University; Ph.D., Brandeis University.

Sharon George, Assistant Professor, Nursing; R.N., B.S., Northeastern University; M.S., University of Lowell.

Lee Ann Hoff, Professor, Nursing; R.N., B.S.N., St. Louis University; M.S.N., The Catholic University of America; Ph.D., Boston University.

Mary Elizabeth Hooker, Assistant Professor, Health and Clinical Sciences; M.T. (ASCP), Cambridge Hospital School of Medical Technology; B.A., Boston University; M.S., Ph.D., Georgetown University.

Linda A. Kahn-D'Angelo, Professor, Physical Therapy; R.P.T., B.A., Merrimack College; M.A., Texas Women's University; D.Sc., Boston University.

Mary Ann Kelly, Assistant Professor, Nursing; R.N., B.S., St. Anselm College School of Nursing; M.S., Boston University School of Nursing; Ed.D., Boston University.

Pauline Ladebauche, Assistant Professor, Nursing; R.N., B.S., Lowell State College; M.S., Boston University.

Jacob W. Lam, Professor, Health and Clinical Sciences; B.S., University of Illinois; M.S., University of Tennessee Knoxville; Ph.D., University of Massachusetts at Amherst.

Jan Louise Leonard, Instructor, Nursing; R.N., B.S., University of Rochester School of Nursing; M.S.N., Boston University School of Nursing.

Barbara Mawn, Assistant Professor, Nursing; R.N. Diploma, Massachusetts General Hospital School of Nursing;

B.S.N., Northeastern University; M.S., Boston University School of Nursing; Ph.D., Brandeis University.

Lisa McCurley, Assistant Professor, Nursing; R.N., B.S., University of Lowell; M.S.N., University of Massachusetts Boston.

Arlene McGrory, Assistant Professor, Nursing; R.N. Diploma, The Charles E. Gregory School of Nursing of Perth Amboy General Hospital; B.S.N., Russell Sage College; M.S.N., Boston University; D.N.Sc., Boston University.

Shashikant R. Mehta, Associate Professor, Health and Clinical Sciences; B.S., University of Bombay; M.S., University of Scranton; Ph.D., University of Texas, Houston.

Karen Melillo, Professor, Nursing; R.N., B.S., Salem State College; M.S., University of Lowell; Ph.D., Brandeis University.

Theodore Namm, Professor, Health and Clinical Sciences; B.S., M.S., Fordham University; Ph.D., University of New Hampshire.

Robert Neal, Professor, Health and Clinical Sciences; B.A., University of Massachusetts; M.Ed., Ed.D., Boston University.

Robert J. Nicolosi, Professor, Health and Clinical Sciences; B.A., St. Anselm College; M.S., Ph.D., University of New Hampshire.

Michael O'Sullivan, Assistant Professor, Health and Clinical Sciences; B.A., Northeastern University; M.P.H., D.P.H., University of California, Berkeley.

Susan O'Sullivan, Associate Professor, Physical Therapy; B.S., M.S., Ed.D., Boston University.

Carole W. Pearce, Assistant Professor, Nursing; R.N. Diploma, Butterworth School of Nursing; A.S., Michigan State University; B.S.N., St. Anselm College; M.S., Boston University; Ph.D., Boston College.

Sheila Perrault, Assistant Professor, Nursing; R.N., B.S.N., M.S.N., Salem State College.

Vincent C. Pivnicny, Associate Professor, Health and Clinical Sciences; A.B., Lafayette College; M.S.B.A., Boston University; Ph.D., University of Pittsburgh.

Laurel E. Radwin, Assistant Professor, Nursing; R.N., A.S. Nursing, Santa Monica College; B.S.N., Northeastern University;

M.S.N., Boston College; Ph.D., Boston College.

Susan Reece, Associate Professor, Nursing; R.N., B.S., Russell Sage College; M.S., Boston College; D.N.Sc., Boston University.

Eugene Rogers, Professor, Health and Clinical Sciences; M.T. (ASCP), B.S., Lowell State College; M.S., Ph.D., Northeastern University.

Connie Seymour, Assistant Professor, Physical Therapy; M.S., California State Polytechnic University; M.P.T., Baylor University; Ph.D., University of Toledo.

Deborah Sigman, Assistant Professor, Nursing; R.N., B.S., M.S., Salem State College.

Janice M. Stecchi, Professor, Nursing; R.N., B.S.N., Boston College; M.Ed., Salem State College; M.S., Ed.D., Boston University.

Beverly J. Volicer, Professor, Health and Clinical Sciences; B.A., University of Iowa; M.A., M.P.H., Ph.D., University of Michigan.

Joyce White, Associate Professor, Physical Therapy; B.S., University of Connecticut; M.S., Boston University; D.Sc., Boston University.

Joyce Wells, Instructor, Nursing; R.N. Diploma, Mt. Auburn Hospital School of Nursing; B.S.N., Fitchburg State College; M.S.N., University of Massachusetts, Worcester.

Eileen Williamson, Associate Professor, Nursing; R.N., B.S., Lowell State College; M.S., D.N.Sc., Boston University.

Professional Support Staff

Hermine Cleary, Director, Nursing Laboratories; R.N., B.S., Salem State College; M.S., Northeastern University.

Lisa Falvo, Academic Coordinator of Clinical Education, Physical Therapy; B.S., University of Lowell; M.S., Springfield College.

Nancy Grandbois, Clinical Medical Technology; M.T. (ASCP), B.A., B.S., Cedar Crest College; M.S., Northeastern University.

Patrick Scollin, Director, Computer Laboratories; M.T. (ASCP), B.A., St. Anselm College; M.S., Northeastern University.

College of Management



The College of Management (COM) is fully accredited at the undergraduate and graduate levels by the American Assembly of Collegiate Schools of Business (AACSB). The College offers undergraduate programs of study leading to the Bachelor of Science in Business Administration (BSBA) with concentrations in five areas of management and the Bachelor of Science in Industrial Management (BSIM). Refer to the Graduate School Catalog for information about graduate programs in the College. Following the AACSB philosophy, the College endeavors to create the intellectual climate required to offer a dynamic, high quality undergraduate education in management through a challenging curriculum. To enhance the quality of the management program, the faculty of the College is actively engaged in research, consulting, and other scholarly activities designed to support a major focus on institutional excellence.

The College of Management promotes economic development by offering high quality and interdisciplinary educational programs, internships, and by conducting both applied and theoretical research, that enhance manufacturing and other sectors of the economy. These activities provide students with the knowledge, skills and sound ethical foundations to function effectively in a rapidly changing global environment.

Programs are designed to foster the development of broad integrative skills, using leading edge business technology, and a problem solving orientation that can be applied to all functional areas of management. The emphasis is to facilitate achievement of corporate as well as broader economic and national goals through the analysis and advocacy of private and public sector policies and practices that enhance organizational performance in an internationally competitive environment.

Kathryn Verreault, Ph.D., Interim Dean

Objectives of the College of Management

The faculty of the College has developed curricula intended to provide an education at the leading edge of the theory and practice of management. Graduates will be able to function successfully as professionals in business and non-business organizations. The College's faculty actively engages in research and publishes widely in professional journals. The College places a high value on classroom instruction. A variety of teaching methods are utilized with emphasis on lecture and case method techniques.

The College also participates in efforts to revitalize the region's economy. The resources and experience of the College faculty and students are available to assist in the solution of problems faced by business and governmental units in the state, region, and beyond.

College Organization and Governance

The College is organized into three departments: Accounting, Management (which houses Finance, Management and Marketing), and Manufacturing/Management Information Systems. The faculty of the College has overall responsibility for academic policies of the College.

General College Requirements

Candidates for undergraduate degrees must satisfy the general University requirements for graduation and must complete all requirements as specified by one of the established curricula within the College.

Students may elect a second concentration in the College of Management provided they complete all requirements specified by the concentration. Students who matriculate in other colleges of the University may minor in Business Administration.

Residency Requirement

In addition to the minimum University residency requirements, the College of Management requires the senior year work, with minor exceptions, to be taken in residence at the University of Massachusetts Lowell.

Declaration of Program

Students enrolled in the College of Management are required to specify their degree program upon enrollment. Students pursuing the Bachelor of Science in Business Administration degree follow a core program for the first two years and after completing specific filter courses must apply to be admitted to the upper division and to declare a concentration with the Office of Enrollment Services. During the first semester of their senior year, students in both the BSBA and BSIM degree programs are required to file a Declaration of Intention to Graduate (DIG) form with their advisor or the department's designated DIG officer.

Policies for Undergraduate Programs

I. Undergraduate Admission Requirements

Students entering the University as a freshman in the College of Management must be registered as Industrial Management (IM) if pursuing the BSIM degree, or Business Administration (BA) if pursuing the BSBA degree. Upon completion of the first semester of the sophomore year, BA students may apply to be admitted to the upper division program and to declare a concentration. The College offers concentrations in Accounting, Finance, Management, Marketing and Management Information Systems (MIS).

Transfer students may apply for transfer admission to the College of Management according to the transfer rules described in sections II and III below. Business Administration students may apply for admission to upper division COM programs described in section III on the following page.

II. Undergraduate Transfer Rules

The College of Management welcomes transfer students from Massachusetts community colleges and other regionally accredited institutions to the BSBA and BSIM programs. All College of Management students including transfer students from other accredited institutions and from other colleges of University of Massachusetts Lowell initially enter the BSBA program as Business Administration students. After completing the filter

courses, students apply to be admitted to the upper division and to declare a concentration according to the upper-division admission policies stated in section III on the following page. Students entering UMass Lowell with an associate degree may apply to be admitted directly to the upper division. Transfer students who have not earned an associate degree and transfer more than 45 credits toward the BSBA program may apply to be admitted to the COM upper division after completion of the filter courses. Students wishing to transfer to the BSIM program should have at least a 2.300 (on a 4.000 scale) grade point average. All students must complete at least 60 academic credits in residence at University of Massachusetts Lowell subject to exceptions specified in this catalogue.

A. Transfer From Other Institutions

Students transferring to the College of Management from any program not included in the Commonwealth Transfer Compact, with or without an associate degree, must have a cumulative grade point average of at least 2.000/4.000. Students wishing to transfer to the BSIM program should have at least a 2.300/4.000 grade point average. Students may not transfer any course in which they earned a grade of less than C (1.700 on a 4.000 scale). Courses at a level below the first COM requirements, such as algebra or the first semester of a two semester precalculus sequence, are not transferable. Also, courses deemed equivalent to: Organizational Behavior, Business Finance, Operations Management, and Management Information Systems, taught by the College as part of its upper division core must be validated by departmental exam provided the course was taken after completing the prerequisites and a grade of C or better was earned in each of these courses. Courses that are equivalent to courses taught by the College in the upper division (junior and senior level) which are not a part of the COM core requirements cannot be used to satisfy the minimum degree requirements of the BSBA degree in the College of Management.

*College Policies and Requirements***Transfer From Massachusetts Community Colleges**

Students transferring with an Associate in Science, Business Transfer Option, from a member of the Commonwealth Transfer Compact can transfer all courses up to a maximum of sixty-six (66) credits. Although all transferred courses are listed on the student's transcript, due to differences in program requirements at different institutions, some courses may not apply to minimum degree requirements at the College of Management. Courses at a level below the first COM requirements, such as algebra or the first semester of a two semester precalculus sequence, are examples of such courses. However, the student transferring with an associate degree, Business Transfer Option, will be eligible to take upper level courses in the College of Management subject to the stated prerequisites for each course. Additionally, courses at these institutions deemed equivalent to the upper level COM core (Organizational Behavior, Business Finance, Operations Management, and Management Information Systems) may also be transferred providing: a) the course was taken after completing the prerequisites; b) a grade of C or better was earned in the course; c) the appropriate validation exam was passed; and d) a written articulation agreement covering the course exists between the College of Management and the institution from which the student is transferring. Courses taught by the College as part of its upper division core that are not acceptable for transfer may be validated by departmental exam. Courses that are equivalent to courses taught by the College in the upper division (junior and senior level) which are not a part of the COM core requirements cannot be used to satisfy the minimum degree requirements of the BSBA degree in the College of Management. A student transferring to the College of Management with an associate degree is prohibited by University policy from pursuing further off-campus study.

B. Intercollegiate Transfer

An intercollegiate transfer student to the College of Management must be in good standing and have completed at least 15 credits at the University of Massachusetts Lowell. Upon acceptance, the student will be listed as Business Administration (BA) or Industrial Management (IM) and will

usually be permitted to enroll only in lower division courses.

The transfer request is normally initiated by the student and is submitted to the College of Management. Students must submit a completed change of major form obtained from the Office of Enrollment Services, the Office of the Dean of the College, or any department in the College.

University of Massachusetts Lowell students intending to apply for intercollegiate transfer to the College of Management should do so preferably before completing 60 credits (prior to completing the sophomore year). This will minimize delays in completing their educational objectives since COM upper division courses are restricted to juniors and seniors in the College of Management with appropriate prerequisites who have been admitted to upper division according to rules stated in Section III of the Policies for Undergraduate Admissions.

C. Transfer From Other COM Departments

Once admitted to the College of Management upper division program, a student can choose to enroll in any concentration within COM. Depending on the number of unrestricted electives available in the curriculum of the concentration a student is entering and the number of credits completed by the student at the time of transfer, some courses may not be usable in the student's new program, requiring the student to take courses above and beyond the University's minimum graduation credit requirements. All courses stay on the student's transcript at the University and are included in the determination of the cumulative grade point average as specified by University policies. No student shall be permitted more than two intercollegiate transfers.

III. Admission to Upper Division

All BSBA students must apply to be admitted to the upper division program in a concentration of their choice upon completion of the filter courses listed below. Minimum criteria for admission to upper division is an overall grade point average of 2.000/4.000.

- 60.201 Accounting/Financial
- 49.201 Economics I

- 49.211 Statistics I
- 92.122 Differential Calculus
- 42.101 College Writing I
- 42.102 College Writing II
- 47.101 General Psychology
- 48.101 Intro. to Sociology

For students transferring from another institution, a course deemed equivalent to any of the above courses by the College of Management will be used to meet this requirement.

Application for admission is submitted directly to the office of the Dean. The application must include: a completed change of major form obtained from the Office of Enrollment Services, the Office of the Dean of the College, or any department in the College.

Admission to the College of Management upper division is guaranteed for a transfer student if she/he has completed an Associate in Science, Business Transfer Option, and the above mentioned courses.

Individuals who are not eligible to declare a concentration after earning 60 credits but who satisfy University retention requirements may file for intercollegiate transfer within the university. Students who are ineligible to file for intercollegiate transfer or are denied admission to another college following application for intercollegiate transfer are dismissed from the University.

IV. Special Academic Policies for Undergraduates

The following rules govern the applicability of courses satisfying curriculum requirements in any COM concentrations:

A. A student may transfer a course that COM offers in its upper division (junior and senior years) if the course was taken by the student in a school accredited by the American Assembly of Collegiate Schools of Business (AACSB) and a grade of 'C' or better was earned. The only exception is for courses designated as introductory business core courses by COM (for example, Business Finance, Marketing Principles, Organizational Behavior, etc.) which may be transferred subject to passing a written validation examination administered by the appropriate COM department. A copy of the completed written examination must be submitted to the College of Management

COLLEGE OF MANAGEMENT

College Policies and Requirements

to be placed in the student's permanent COM file.

B. Upper division College of Management courses (300 and 400 level) are restricted to matriculated students who have been admitted to the upper division program and have completed all prescribed prerequisites. Transfer students may not count any courses that require validation or which are not creditable to the COM concentration towards this requirement.

C. COM upper division courses are restricted to:

1. juniors and seniors enrolled in COM;
2. juniors and seniors enrolled in another college of the University whose major requires completion of specific business courses; and
3. special students who meet appropriate prerequisites.

D. All College of Management students must take all upper division management courses in the day program.

E. An unrestricted (free) elective (designated non-COM) for COM students is any course that satisfies one of the following criteria:

1. a 100 level course from any college;
2. a course designated as an intercollegiate course by any college of the University;
3. an unrestricted course from the College of Arts and Sciences;
4. a course listed as satisfying a University area distribution requirement;
5. a course that applies towards a student's minor in another college;
6. any course in the College of Management that is not specifically required by the student's department and is not otherwise restricted; or
7. a course allowed by an approved academic petition.

Any course taken in violation of these rules may not be used to fulfill COM curriculum requirements regardless of the grade.

V. Graduation Requirements

In addition to satisfying degree requirements listed in this catalogue under "University Academic Policies" and under "College of Management," COM majors must also satisfy the following requirements:

A. Residency Requirement

COM majors must take all required upper division courses in residence in the day programs of COM. Any exceptions to this (for international study, etc.) must be approved by the appropriate department chairperson and the Office of the Dean prior to enrolling in such courses. No approvals for transfer credit of any required course taken at any other institution will be granted after the course has been completed except as noted above for transfer students.

B. Degree Requirements

In order to qualify for a baccalaureate degree offered by the College of Management, each undergraduate student must satisfy all course requirements applicable to the major and their area of concentration and must earn a cumulative grade point average of 2.000 in all courses.

Baccalaureate Degree Programs

Bachelor of Science in Industrial Management

In cooperation with the College of Engineering, the College of Management offers the Bachelor of Science in Industrial Management program. This program is designed to provide students with a specialized education in technological and management areas.

The Industrial Management curriculum combines the elements of a program in operations management and manufacturing with a basic foundation in engineering. The Industrial Management graduate is equipped to assume managerial and administrative responsibilities in technologically-oriented firms including the management of complex production activities or the marketing of specialized equipment.

Course of Study for Industrial Management

(Bachelor of Science in Industrial Management)

Freshman Year

Fall Semester

25.105	Engineering I Graphics	2
25.110	Intro to Materials	5
42.101	College Writing I	3
49.201	Economics I	3
84.121	Chemistry I	3
84.123	Chemistry I Lab	1
92.131	Calculus I	4
		16.5

Spring Semester

42.102	College Writing II	3
47.101	Introduction to Psych	3
49.202	Economics II	3
92.132	Calculus II	4
25.106	Eng. I: Graphics	2
	Free Elective	3
		18

Sophomore Year

Fall Semester

22.201	Mech Design Lab I	2
48.101	Intro to Sociology	3
60.201	Accounting/Financial	3
92.234	Differential Equations	3
95.141	Physics I	3
96.141	Exp Physics I Lab	1
		15

Spring Semester

22.202	Mech Design Lab II	2
92.386	Stats for Sci. and Eng.	3
60.202	Accounting/Managerial	3
63.210	Operation Anal Tech	3
95.144	Physics II	3
96.144	Exp Physics II Lab	1
		15

Junior Year

Fall Semester

16.211	Fund of Electricity	3
22.211	Eng Mechanics I	3
62.201	Marketing Principles	3
60.331	Cost Mgmt Systems	3
63.371	Operations Management	3
		15

Department of Accounting

Spring Semester

10.308	Engineering Materials	3
10.347	Thermo and Heat Trans	3
61.301	Business Finance	3
66.301	Organizational Behavior	3
	Elective, Aesthetic	3
		15

Senior Year**Fall Semester**

22.473	Design for Manufacturing	3
63.301	Mgmt Info Systems	3
63.471	Managerial Quality Control	3
	Human Values Elective	3
	Elective, Literature	3
		15

Spring Semester

63.475	Sim of Mfg Systems	3
66.490	Strategic Management	3
	Elective, IM/COM*	3
	Elective, non-COM global	3
	Elective, Free	3
		15

*IM/COM electives: See your College of Management IM advisor.

Bachelor of Science in Business Administration

The Bachelor of Science in Business Administration degree is designed to provide students with a foundation in the liberal arts and sciences, as well as the analytical skills and specialized professional courses which will enable them to function as effective professional managers. Course work in the first two years focuses on the liberal arts, mathematics, sciences and introductory professional skills courses. These subjects provide the foundation on which the advanced courses are built. In the liberal arts and sciences, emphasis is upon written English, the behavioral and social sciences, and mathematics. The professional skill courses include accounting, economics, and statistics.

As juniors and seniors, students concentrate in professional programs offered by the College of Management. The College curriculum offers concentrations in five areas of management: Accounting, Finance, Management, Marketing, and Management Information Systems (MIS). The upper-level curriculum starts with

introductory management courses covering the functional areas found in organizations. Through the junior and senior year each student will complete a course of study in at least one concentration. Given the increasing importance of global competition and its impact on both public and private sectors in the U.S., the College also includes an international component in all curricula. Regardless of concentration, students have sufficient electives to permit them to tailor their programs to their special interests.

Minor in Business Administration

The College of Management has a Business Administration minor for students not majoring in the College. Students must file a Declaration of Minor form with the College before registering for 300 level courses. In order to earn a minor, students must file with the Office of Enrollment Services, an academic petition approved by the College of Management. This should be done immediately after registering for the courses that will complete the minor. Courses required for the minor are as follows:

Semester I

49.201	Economics I
60.201	Accounting/Financial

Semester II

62.201	Marketing Principles
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Semesters III and IV

61.300	Introduction to Investments
63.301	Management Info Systems
66.301	Organizational Behavior
	COM Elective

Department of Accounting

Charles Thompson, Chairperson

Professors: Clairmont P. Carter,

Charles F. Feeney, Linda H. Kistler

Associate Professors: Samuel Chesler,

J. Stephen Collins, John G. Hamer, Norma Powell, Sherre Strickland,

Charles Thompson, Kathryn Verreault

Accounting Concentration

(Bachelor of Science in Business Administration)

The accounting concentration prepares students for professional positions in management accounting, industry, or public accounting by providing students with quantitative analytical skills necessary for developing and analyzing financial information for all types of institutions. Data accumulation, analysis, and interpretation, together with communication of results, are fundamental activities of professional accountants. The accounting courses contain numerous general ledger and spreadsheet projects, reinforcing computer literacy and project orientation.

Course of Study for Business Administration**Accounting Concentration**

(Bachelor of Science in Business Administration)

Freshman Year**Fall Semester**

42.101	College Writing I	3
47.101	General Psychology	3
92.121	Precalculus (or non-COM)	3
46.	Elective, Political Science	3
	Elective, Science w/ Lab	4
		16

Spring Semester

42.102	College Writing II	3
48.101	Sociology	3
92.122	Differential Calculus	3
43.	History Elect	3
	Elective, non-COM Global	3
		15

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Department of Accounting

Sophomore Year

Fall Semester

60.201	Accounting/Financial	3
49.211	Statistics	3
49.201	Economics I	3
	Elective, non-COM	3
	Elective, non-COM	3
		15

Spring Semester

60.202	Accounting/Managerial	3
62.201	Marketing Principles	3
49.202	Economics II	3
63.210	Operations Analysis	3
	Elective, Science w/ lab	4
		16

The junior and senior curriculum may be revised prior to a student achieving junior status.

Junior Year

Fall Semester

60.301	Intermed Accounting I	3
60.321	Cost Accounting	3
63.301	Mgmt Info Systems	3
61.301	Business Finance	3
	Elective, Aesthetics	3
		15

Spring Semester

60.302	Intermed Accounting II	3
60.303	Accounting Info. Systems	3
66.301	Organizational Behavior	3
63.371	Operations Management	3
	Elective, COM	3
		15

Senior Year

Fall Semester

60.401	Advanced Financial Acct.	3
60.	Elective, Accounting	3
	Elective, COM	3
	Elective, Literature	3
	Elective, non-COM	3
		15

Spring Semester

60.431	Federal Income Taxes	3
66.490	Strategic Management	3
	Elective, COM or non-COM	3
	Elective, non-COM	3
	Elective, non-COM	3
		15

Accounting
(Course Prefix: 60)

60.201 Accounting/Financial

Presents a comprehensive, detailed exposure to basic accounting theory. Beginning with the accounting equation, the student is introduced to the accounting cycle, preparation of the statement of financial position and the income statement, accounting for the assets, liabilities, and stockholders' equity of the firm, and cash flow and financial statement analysis. 3 cr.

60.202 Accounting/Managerial

Examines the use of accounting systems for managerial decision making. Budgeting, forecasting, and cost accumulation systems which relate to manufacturing firms will be studied. Prerequisite: 60.201. 3 cr.

60.301 Intermediate Accounting I

Examines the generally accepted accounting principles relating to the preparation of financial statements. The student will study, in depth, the valuation and disclosure problems associated with the assets of the firm. Prerequisite: 60.202. 3 cr.

60.302 Intermediate Accounting II

Presents the in-depth study of the valuation and disclosure problems associated with corporate liabilities and stockholders' equity. Emphasis is placed on the pronouncements of the Financial Accounting Standards Board. Prerequisite: 60.301. 3 cr.

60.303 Accounting Information Systems

Provides an analysis of modern accounting information systems. Topics include the design, implementation, and evaluation of information systems, including computer applications. Prerequisite: 60.301. 3 cr.

60.321 Cost Accounting

An examination of the manufacturing function from the view of the cost accountant. Managerial control of the elements of product costs will be studied with an emphasis on cost accumulation systems both historical and estimated. Prerequisite: 60.202. 3 cr.

60.331 Cost Management Systems

This course is an upper level management accounting course for non-accounting majors. It takes a decision-oriented approach and focuses on the manager's view, as opposed to the accountant's view,

of the decision process and its related information needs. Traditional cost accounting and new cost management models will be explored and contrasted, but the emphasis will be on cost management systems which examine a proactive role in planning, managing, and reducing costs. Prerequisite: 60.202. 3 cr.

60.401 Advanced Financial Accounting I

Explores theoretical and practical problems in accounting for large, multicorporational business entities. Consolidation, mergers, home office/branch accounting, and international accounting topics receive in-depth study. Prerequisite: 60.302. 3 cr.

60.402 Advanced Financial Accounting II

Offers a comprehensive study of partnership accounting, accounting for installment and consignment sales, and also includes an introduction to accounting for nonprofit organizations (government, educational units and hospitals). Prerequisite: 60.401. 3 cr.

60.421 Auditing

An examination of the purposes of financial and operations auditing. The following topics will be examined in depth: auditing standards, professional ethics, legal responsibilities, internal control, audit evidence, financial statement disclosures, audit reports, management advisory services, and internal auditing. Prerequisite: 60.303. 3 cr.

60.423 Financial Accounting Theory and Practice

An in-depth examination is made of the theory and practice of specific financial accounting topics. Prerequisite: 60.302. 3 cr.

60.431 Federal Income Taxes

Deals with the basic rules and regulations of the Internal Revenue Code as it affects the individual and the corporation. An understanding of the code is developed through lectures, assigned readings, research, and the solution of a wide variety of problems. Prerequisite: 60.202. 3 cr.

60.432 Advanced Federal Taxation

Deals with the rules and regulations of the Internal Revenue Code as it affects corporations, estates and trusts. Emphasis will be on special corporate problems including incorporation, distributions and liquidations. Prerequisite: 60.431. 3 cr.

*Department of Management/Finance and Marketing***60.441 Accounting for Not For Profit Institutions**

Examines financial accounting methods, principles and systems, as related to state, county and local governments, colleges and universities, and hospitals. While fund accounting concepts provide the general framework of the course, expenditure controls are given particular attention through an examination of appropriation and encumbrance accounting.

Prerequisite: 60.302. 3 cr.

60.451 Controllership

Functions and procedures of the controller in modern business are examined. Emphasis is placed upon control systems which safeguard assets and assist in efficient utilization of the firm's resources. Special attention is placed upon long-range operational planning and control.

Prerequisite: 60.302. 3 cr.

60.499 Research Seminar

Designed for upperclass accounting majors who wish to do research and/or investigate special topics of interest in accounting. Prerequisite: permission of instructor. 3 cr.

Department of Management/Finance and Marketing

Yash Puri, Chairperson

Professors: Gerald F. Downey,

Stuart C. Freedman, Braxton Hinchey, Timm L. Kainen, Stuart L. Mandell (Emeritus), Santo J. Pullara, Yash R. Puri, Irwin A. Shapiro

Associate Professors: Clare L. Comm, Valerie Kijewski, Martin R. Moser, Eunsang Yoon

Assistant Professors: Brooke D. Hargreaves-Heald, Sangphill Kim

The Department of Management/Finance and Marketing offers three concentrations within the Bachelor of Science in Business Administration.

Management Concentration

(Bachelor of Science in Business Administration)

American management in the 1990's and beyond will continue to face significant change in the internal and external business environment. Rapid technological innovation, increasing international competitiveness in manufacturing and other sectors, a more diverse labor force, and employees who increasingly expect a high quality work life represent only some of those changes that directly affect the health and vitality of our economy.

The purpose of the management concentration is to produce skilled managers able to perform effectively under these conditions and contribute to economic development. The program's goal is also to develop creative leaders for management positions who have strong behavioral skills and an integrated, problem-centered approach to decision making, and who will act in accordance with society's values and ethical standards. Our strategy is to offer a high quality academic program that will prepare graduates for a rapidly changing regional, national, and global environment.

We emphasize in our curriculum the development of skills needed to a) accurately assess current and emerging busi-

ness conditions, and b) create new, more flexible, organizational forms and work systems that foster effective, high quality performance in manufacturing and other sectors of the economy. This emphasis will teach students how both jobs and organizations can be designed and managed in ways that "fit" external conditions and encourage employee creativity and successful exploitation of new business opportunities.

Course of Study for Business Administration**Management Concentration**

(Bachelor of Science in Business Administration)

Freshman Year**Fall Semester**

42.101	College Writing I	3
47.101	General Psychology	3
92.121	Precalculus (or non-COM)	3
46.	Elective, Political Science	3
	Elective, Science w/ Lab	4
		16

Spring Semester

42.102	College Writing II	3
48.101	Sociology	3
92.122	Differential Calculus	3
43.	Elective, History	3
	Elect, non-COM Global	3
		15

Sophomore Year**Fall Semester**

60.201	Accounting/Financial	3
49.211	Statistics	3
49.201	Economics I	3
	Elective, non-COM	3
	Elective, non-COM	3
		15

Spring Semester

60.202	Accounting/Managerial	3
62.201	Marketing Principles	3
49.202	Economics II	3
63.210	Operations Analysis	3
	Elective, Science w/ lab	4
		16

The junior and senior curriculum may be revised prior to a student achieving junior status.

COLLEGE OF MANAGEMENT

Department of Management/Finance and Marketing

Junior Year

Fall Semester

66.301	Organizational Behavior	3
61.301	Business Finance	3
63.371	Operations Mgmt	3
60.331	Cost Mgmt Systems	3
	Elective, non-COM	3
		15

Spring Semester

66.310	Human Res Mgmt	3
63.301	Mgmt Info Systems	3
	Elective, non-COM	3
	Elective, COM or non-COM	3
	Elective, Aesthetics	3
		15

Senior Year

Fall Semester

66.410	Neg. Strat. and Processes	3
66.445	Contemp. Mgmt. Devel.	3
	Elective, COM	3
	Elective, COM	3
	Elective, Literature	3
		15

Spring Semester

66.420	Leadership Processes	3
66.490	Strategic Management	3
	Elective, COM	3
	Elective, COM	3
	Elective, non-COM	3
		15

Finance Concentration

(Bachelor of Science in Business Administration)

The finance concentration is designed to provide students with a strong background in the fundamental concepts of finance, as well as intensive application of financial problem solving and decision making techniques to a broad spectrum of private and public enterprises operating in domestic and multinational environments. The objective of the finance program is to prepare students for a wide variety of positions in financial management, banking, and the securities field.

Course of Study for Business Administration

Finance Concentration

(Bachelor of Science in Business Administration)

Freshman Year

Fall Semester

42.101	College Writing I	3
47.101	General Psychology	3
92.121	Precalculus	3
46.	Elective, Political Science	3
	Elective, Science w/ Lab	4
		16

Spring Semester

42.102	College Writing II	3
48.101	Sociology	3
92.122	Differential Calculus	3
43.	Elective, History	3
	Elect, non-COM Global	3
		15

Sophomore Year

Fall Semester

60.201	Accounting/Financial	3
49.211	Statistics	3
49.201	Economics I	3
	Elective, non-COM	3
	Elective, non-COM	3
		15

Spring Semester

60.202	Accounting/Managerial	3
62.201	Marketing Principles	3
49.202	Economics II	3
63.210	Operations Analysis	3
	Elective, Science w/ lab	4
		16

The junior and senior curriculum may be revised prior to a student achieving junior status.

Junior Year

Fall Semester

61.301	Business Finance	3
66.301	Organizational Behavior	3
60.331	Cost Mgmt Systems	3
63.371	Operations Mgmt	3
	Elective, non-COM	3
		15

Spring Semester

61.303	Methods of Fin Analysis	3
61.300	Intro to Investments	3
63.301	Management Info Sys	3
	Elective, Aesthetics	3
	Elective, COM	3
		15

Senior Year

Fall Semester

61.431	Capital Planning	3
	Elective, COM	3
	Elective, non-COM	3
	Elective, non-COM	3
	Elective, Literature	3
		15

Spring Semester

61.491	International Finance	3
66.490	Strategic Management	3
	Elective, COM	3
	Elective, COM	3
	Elective, COM or non-COM	3
		15

Marketing Concentration

(Bachelor of Science in Business Administration)

Marketing is the process whereby organizations anticipate and adapt to environmental change. Accordingly, successful management of the marketing process requires an appreciation for and understanding of buyer behavior, marketing research, product development, distribution and promotional strategies, and pricing policy. Students graduating in marketing often go on to careers in general management, as well as advertising, sales and sales management, retailing, wholesaling, marketing research, physical distribution, purchasing, or marketing management.

The College of Management and the Purchasing Management Association of Boston have developed a program in the area of purchasing. Marketing students who pursue the purchasing track will take the following courses with purchasing internships available on a competitive basis:

Marketing Electives

62.403	Business Marketing	
62.406	Purchasing & Materials Mgmt	
	Free Electives	
63.372	Operations Planning and Control	
63.471	Managerial Quality Control	

Department of Management/Finance and Marketing

Course of Study for Business Administration**Marketing Concentration**

(Bachelor of Science in Business Administration)

Freshman Year**Fall Semester**

42.101	College Writing I	3
47.101	General Psychology	3
92.121	Precalculus	3
46.	Elective, Political Science	3
	Elective, Science w/ Lab	4
		16

Spring Semester

42.102	College Writing II	3
48.101	Sociology	3
92.122	Differential Calculus	3
43.	Elective, History	3
	Elect, non-COM Global	3
		15

Sophomore Year**Fall Semester**

60.201	Accounting/Financial	3
49.211	Statistics	3
49.201	Economics I	3
	Elective, non-COM	3
	Elective, non-COM	3
		15

Spring Semester

60.202	Accounting/Managerial	3
62.201	Marketing Principles	3
49.202	Economics II	3
63.210	Operations Analysis	3
	Elective, Science w/ lab	4
		16

The junior and senior curriculum may be revised prior to a student achieving junior status.

Junior Year**Fall Semester**

60.331	Cost Management Systems	3
61.301	Business Finance	3
66.301	Organizational Behavior	3
63.371	Operations Mgmt	3
	Elective, non-COM	3
		15

Spring Semester

62.311	Identifying Mkt. Opport.	3
62.312	Marketing Tactics	3
	Elective, COM	3
	Elective, COM	3
	Elective, Aesthetics	3
		15

Senior Year**Fall Semester**

62.313	Sales and Cust. Rel.	3
62.	Elective, Marketing	3
	Elective, COM	3
	Elective, non-COM	3
	Elective, Literature	3
		15

Spring Semester

63.405	Mgmt Info Systems	3
66.490	Strategic Mgmt	3
	Elective, COM or non-COM	3
	Elective, COM	3
	Elective, non-COM	3
		15

Finance (Course Prefix: 61)**61.300 Investments**

Introduction to the principles of investment. Security analysis of stocks and bonds for markets, industries and firms. Primary and secondary capital markets, money markets, and other investment alternatives in terms of risk-return trade-offs. Options and futures as investment alternatives. Emphasis is on fundamental and technical analyses. Prerequisite: 60.201. 3 cr.

61.301 Business Finance

Principles of financial management, including working and fixed capital, sources of funds, financial statements, financial planning and capital structure. Prerequisite: 49.202 and junior standing. 3 cr.

61.302 Money and Banking

Evolution of money and credit and their role in the economy. Monetary policy and the Federal Reserve System. Structure and function of the commercial banking system and the role of other financial institutions. Prerequisite: 49.202. 3 cr.

61.303 Methods of Financial Analysis

The techniques of financial analysis in depth. Topics covered include cash management, credit scoring, receivables monitoring, inventory management, financial statements analysis and forecasting, financial distress prediction, mergers and acquisitions techniques and other selected topics. Prerequisite: 61.301. 3 cr.

61.411 Financial Institutions and Markets

Theoretical and pragmatic aspects of the financial process in the economic system. Analysis of financial intermediation. Prerequisite: 61.302. 3 cr.

61.421 Portfolio and Security Analysis

Advanced course on investment theory and applications. Topics covered include stock market behavior, portfolio and capital market theories, and securities analysis. Prerequisite: 61.300. 3 cr.

61.431 Financial Management

Advanced study of the principles. Emphasis on case analysis and problem solving. Prerequisite: 61.303. 3 cr.

61.432 Advanced Financial Management

Seminar on current topics in finance. Advanced journal readings, computer assignments, and a term project are emphasized. Prerequisite: 61.431. 3 cr.

61.491 International Finance

Financial aspects of international business operations. Evaluation of risks associated with multinational operation and managerial decision making under conditions of financial uncertainty. Prerequisite: 61.301. 3 cr.

61.492 Financial Strategy and Technology

Analysis of the innovation/technology diffusion process. The role of finance concepts and theory in technology adoption and the management of technological change. Prerequisite: 61.432. 3 cr.

61.499 Independent Study in Finance

COLLEGE OF MANAGEMENT*Department of Management/Finance and Marketing***Marketing (Course Prefix: 62)****62.201 Marketing Principles**

The role of marketing in the economy. The elements of the marketing mix - product, price, distribution, and promotion - are discussed in the context of social and political constraints on marketing activity. Prerequisite: 49.201. 3 cr.

62.302 Marketing Research

Analysis of the information gathering function of marketing management. Design, execution and evaluation of marketing research. Prerequisites: 62.301, 49.212. 3 cr.

62.303 International Marketing

The marketing aspect of international business. Cultural dynamics, economics, political and legal constraints as they affect international marketing institutions and practices. Prerequisite: 62.301. 3 cr.

62.311 Identifying Marketing Opportunities

Focuses on the strategic role of marketing as the functions which leads the business to new products and new markets. Emphasis on market development and product development.

62.312 Marketing Tactics

Focuses on tactical process of managing the marketing mix. Emphasis on market penetration. Term project: marketing plan. Career relevance: understand the role of the marketing communications specialist, appreciate sales and service support activities.

62.313 Sales and Customer Relations

Focuses on day-to-day operating decisions in sales, customer service, and account management. Professional selling and sales forecasting. Term projects; Selling exercise, marketing audit. Career relevance: develop understanding of professional selling, retail and wholesale operations, purchasing, and logistics.

62.401 Marketing Communications

Evaluation of various marketing communication methods, including sales promotion and public relations, with an emphasis on advertising. Research, copy writing, scheduling and budgeting from the viewpoint of the marketing manager. Prerequisites: 62.302, 62.303. 3 cr.

62.402 Buyer Behavior

Applications of behavioral theories and techniques to the understanding of consumer and organizational purchasing processes. Prerequisites: 47.101, 48.101, 62.302, 62.303. 3 cr.

62.403 Business Marketing

Special problems in marketing industrial goods. Distribution channels, pricing policies, product line planning and promotional strategy for companies marketing to industrial firms, governmental agencies and other organizations. Prerequisites: 62.302, 62.303. 3 cr.

62.404 Physical Distribution Management

Social and economic aspects of transportation problems as revealed by analysis of the nature, history, and problems of the American transportation industry. Management of the distribution function: warehousing, inventory control, material handling and industrial packaging. Prerequisites: 66.371, 62.302. 3 cr.

62.405 Sales Management

Management of the personal selling function. Principles of sales force organization, selection, training, compensation, supervision and motivation are explored via appropriate cases. Prerequisites: 62.302, 62.303. 3 cr.

62.406 Purchasing and Materials Management

Purchasing procedures, inventory control, quality control, source selection, forward buying and speculation for the production enterprise. Prerequisites: 62.302, 62.303. 3 cr.

62.407 Retailing

Development, organization and management of various types of retailing institutions. Evaluation of retail locations and contemporary retailing problems. Prerequisites: 62.302, 62.303. 3 cr.

62.408 Product Management

Evaluation of the issues, strategies, and tasks that must be planned and managed when developing and marketing new.

62.409 Marketing Models

Examination of quantitative and qualitative models in marketing decision making. Use of computer spreadsheets to build simple models for solving marketing problems. Prerequisites: 62.302, 62.303. 3 cr.

62.423 Marketing Strategy

Formulation, implementation and control of the firm's marketing strategies and plans. Case study of the behavioral, quantitative and environmental aspects of marketing decision-making. Prerequisite: graduating senior standing. 3 cr.

62.494 Foreign Area Analysis

Directed study in acquisition of in-depth knowledge of culture, economic and business conditions, data sources, etc., for a selected region or country. Prerequisites: graduating COM senior, permission of instructor. 3 cr.

62.496 Special Topics in Marketing

Senior seminar covering marketing topics not typically addressed in regularly scheduled courses. Prerequisites: 62.302, 62.303, permission of instructor. 3 cr.

62.498 Multinational Business Policy

Integration of knowledge from the various functional areas of business administration toward solution of problems affecting the character and success of the total enterprise. Point of view of the chief executive officer operating in an international setting. (Equivalent to 66.490) Prerequisite: graduating COM senior. 3 cr.

62.499 Marketing Internship

Specific projects undertaken by senior marketing students under joint supervision of department internship coordinator and representative from the business organization hosting the internship. Enrollment restricted to marketing seniors selected by internship coordinator. P/NC (free elective credit) only. 3 cr.

**Management
(Course Prefix: 66)****66.301 Organizational Behavior**

Examination of individuals, groups and organizations from a behavioral and structural perspective. Topics include employee motivation and satisfaction, work group dynamics and processes, conflict management, and organizational structure and design. Prerequisite: junior standing. 3 cr.

66.310 Human Resources Management

Current issues in the management of human resources. Recruitment, selection work force training and development. Managing reward systems, employee

Department of Manufacturing/Management Information Systems

health and safety, performance evaluation and human resource planning.
Prerequisite: 66.301. 3 cr.

66.315 Organization Development

Planned organizational change using the theory and technology of applied behavioral science. Intervention strategies at the individual, group and organizational levels are explored. Prerequisite: 66.301. 3 cr.

66.320 Business Research Methods

Examination of various research tools applicable to problems in human resources management and other management disciplines. Credit not given for students who have taken 62.302.
Prerequisites: 66.301 and 49.212. 3 cr.

66.410 Negotiation Strategies and Processes

The ability to recognize situations that require influence skills does not necessarily produce the skills to deal with it successfully. Negotiation is a complex human activity, involving dynamic interpersonal processes. It requires the intellectual ability to understand the key factors that shape and characterize different negotiation situations; the analytical skill to diagnose potential areas of difference and select appropriate strategies to address them; the interpersonal skills to tactically manage the specific communication and decision-making behaviors during the actual bargaining; and the ability to recognize how one's own personality, value system and perceptions affect the choice of tactics and behavior. Prerequisite: 66.301. 3 cr.

66.415 Work System Design

Examination of a wide array of alternative work arrangements, including those developed in other societies and cultures. Issues in flexible job design and employee participation in planning and decision making are addressed. Develops a framework for analysis, guidelines for successful implementation, and a foundation for the successful management of various work systems. Prerequisite: 66.301. 3 cr.

66.420 Leadership Processes

Examines leadership as a dynamic influence process in organizations. The role of leader characteristics and styles; matching leadership behavior and situations; issues in participation; conditions for leadership effectiveness. Prerequisite: 66.301. 3 cr.

66.425 Labor-Management Relations

An examination of current and emerging issues in labor-management relations in manufacturing and other settings. Unions and collective bargaining arbitration, grievance procedures, negotiation processes, and implementation of labor agreements are addressed. Prerequisite: 66.301. 3 cr.

66.430 Compensation Management

Examination of theories and approaches relevant to the design and implementation of monetary and non-monetary reward systems in manufacturing and service organizations. Topics include job analysis and evaluation, pay structures, salary surveys, pay for performance, and compensation administration. Prerequisite: 66.301. 3 cr.

66.435 Comparative Management

A comparison of management concepts, systems and practices in different societies, and institutional settings. The impact of economic, social, political, and cultural variables on management styles, processes and organizational structures. Prerequisite: 66.301. 3 cr.

66.440 International Business

Special problems of overseas operations of American firms. Financial, marketing, human resource, and legal problems of the multinational enterprise. State trading, economic integration and international regulatory agencies. Prerequisites: 49.202, 61.301, 62.301, 63.371 and 66.301. 3 cr.

66.480 Current Topics in Management

Topics of current interest in management. Subject matter to be announced in advance. Prerequisite: 66.301. 3 cr.

66.490 Strategic Management

An integration of knowledge in the various functional areas of management toward solution of problems affecting the character and success of the total enterprise. Corporate strategy and its implementation via appropriate policies. Prerequisites: 96 credits and 61.301, 62.301, 63.372 and 66.301. 3 cr.

66.499 Independent Study in Management

An opportunity for the student to carry out individualized study relating to the field of management under the supervision of a member of the faculty. Prerequisites: Senior standing and permission of the instructor. 3 cr.

Department of Manufacturing/Management Information Systems

Efrem G. Mallach, Chairperson

Professors: M. Riaz Khan, David A. Lewis, James P. Monahan, Louis E. Yelle

Associate Professors: Goang-Tzer Liaw, Efrem G. Mallach, Joyce S. Mehrling, Leo L. Pipino

Assistant Professor: Reza Barkhi

The Department of Manufacturing/Management Information Systems offers two concentrations within the Bachelor of Science in Business Administration.

Management Information Systems Concentration

(Bachelor of Science in Business Administration)

The Management Information Systems concentration (MIS) exposes students to the application of computer-oriented systems techniques and concepts applicable to a wide variety of business problems. Students are trained to help select, use, and manage the ever changing information resources of the firm.

Course of Study for Business Administration

Management Information Systems Concentration

(Bachelor of Science in Business Administration)

Freshman Year

Fall Semester

42.101	College Writing I	3
47.101	General Psychology	3
92.121	Precalculus	3
46.	Elective, Political Science	3
	Elective, Science w/ Lab	4
		16

Spring Semester

42.102	College Writing II	3
48.101	Sociology	3
92.122	Differential Calculus	3
43.	Elective, History	3
	Elect, non-COM Global	3
		15

COLLEGE OF MANAGEMENT

Department of Manufacturing/Management Information Systems

*Sophomore Year***Fall Semester**

60.201	Accounting/Financial	3
49.211	Statistics	3
49.201	Economics I	3
	Elective, non-COM	3
	Elective, non-COM	3
		15

Spring Semester

60.202	Accounting/Managerial	3
62.201	Marketing Principles	3
49.202	Economics II	3
63.210	Operations Analysis	3
	Elective, Science w/ lab	4
		16

The junior and senior curriculum may be revised prior to a student achieving junior status.

*Junior Year***Fall Semester**

60.331	Cost Management Systems	3
61.301	Business Finance	3
66.301	Organizational Behavior	3
63.301	Mgmt Info Systems	3
	Elective, non-COM	3
		15

Spring Semester

63.307	Systems Anal & Design	3
63.371	Operations Mgmt I	3
	Elective, COM or non-COM	3
	Elective, non-COM	3
	Elective, Aesthetics	3
		15

*Senior Year***Fall Semester**

63.	Elective, MIS	3
	MIS Elective (Programming)	3
63.404	Telecom. and Networking	3
	Elective, Literature	3
	Elective, COM	3
		15

Spring Semester

63.403	Database/Comm Mgmt	3
66.490	Strategic Management	3
	Elective, COM	3
	Elective, COM	3
	Elective, non-COM	3
		15

Manufacturing/Management Information Systems (Course Prefix: 63)**63.201 Computer Technology & Business Applications**

An introduction to the processing of information by microcomputers. Topics include: computer logic, memory, input/output, and use of applications software including spreadsheets, graphics, and data bases. 3 cr.

63.210 Operations Analysis Techniques

This course introduces students to quantitative methods for analyzing business problems. Analytic methods include decision analysis, linear programming, queuing and simulation. Applications address issues in areas such as marketing, production, finance, and logistics.

63.301 Management Information Systems

Structure and foundations of information systems for management from both a users and designers perspective. Prerequisite: 63.201 or comparable computer experience. 3 cr.

63.307 Systems Analysis and Design

Study of existing system requirements and design of modifications or a new system. Includes project for actual or hypothetical application. Prerequisite: 63.301. 3 cr.

63.371 Operations Management

Principles of production/operations management. Nature and function of production systems; operational planning and control; plant layout; materials handling, inventory and quality control. Prerequisite: 63.210. 3 cr.

63.372 Operations Planning and Control

Cases on the application of principles from 66.371 to problems involving continuous, intermittent and job lot production systems for both small and large firms. Prerequisite: 66.371. 3 cr.

63.403 Data Base Management and Communication

A two part course addressing major topics in Data Base Management Systems and Data Communications. DBMS topics include discussions of the major models and associated systems, query languages, and the logical and physical design of a

data base. Data Communication topics include basic concepts of point-to-point communication, networks, standards, and management issues. Prerequisites: 63.301, 63.307. 3 cr.

63.404 Business Telecommunications and Networks

This course provides a comprehensive overview in the domain of Business Data Communications and Networking. Information is a critical ingredient for the operation of any organization, and information systems play a vital and increasingly strategic role in the production, management, creative marketing, and delivery of financial services today. This course explores the components of telecommunications in organizations, including how they are used, developed, and managed.

63.406 Decision Support Systems

Study of computer-based information systems that combine the modeling and data retrieval capabilities of the computer to support nonstructured problem solving. Course will present theory and an opportunity to build a working decision support system. Prerequisites: 63.301, 63.307. 3 cr.

63.408 Special Topics in Information Systems

Addresses one or more current topics of importance to the field of Information Systems. Topics can change at each course offering. Typically, the course will focus on an emerging information technology, discussing fundamental concepts and the technology's application to and effect on business. Examples of possible topics are expert systems, hypermedia and hypertext systems, factory automation systems, and the planning for and management of information resources. 3 cr.

63.471 Managerial Quality Control

Views quality control from the total or company-wide perspective. It contains traditional material on statistical process control (SPC), quality cost, quality assurance, quality information systems as well as the recent management theories and ideas of Deming, Jurand, Ishikawa and Taguchi. 3 cr.

63.474 Cases in Operations Analysis

Application of techniques from operations research operations to cases in management decision making including scheduling, inventory control and facilities design. Prerequisites: 63.473 or 92.381, 92.242. 3 cr.

63.499 Independent Study in Operations Management

College of Management Faculty

Reza Barkhi, Assistant Professor; BSCIS (Engineering), MBA, MA (Decision Sciences), Ph.D., The Ohio State University.

Michael Best, Professor; B.A., Central Washington University; M.A., Ph.D., University of Oregon.

Clairmont P. Carter, Professor; B.S., Pennsylvania State University; M.B.A., University of Akron; D.B.A., Kent State University.

Samuel Chesler, Associate Professor; B.S., Boston University; M.B.A., Suffolk University.

J. Stephen Collins, Associate Professor; B.A., Boston College; M.S., Northeastern University; Ph.D., Boston College; C.P.A. (Massachusetts).

Clare L. Comm, Associate Professor; B.S., Miami University; M.B.A., University of Dayton; Ph.D., University of Cincinnati.

Gerald F. Downey, Professor; B.S., M.B.A., Northeastern University; M.S., Ph.D., Boston College.

Charles F. Feeney, Professor; B.S., Boston College; M.B.A., Northeastern University; C.P.A. (Massachusetts).

Stuart C. Freedman, Professor; B.A., City University of New York; M.S., Ph.D., Cornell University.

John G. Hamer, Associate Professor; B.S., University of Lowell; M.B.A., Ph.D., Texas A & M University.

Brooke D. Hargreaves-Heald, Assistant Professor; B.A., Brandeis University; J.D., Northeastern University.

Braxton Hinchey, Professor; A.B., M.A., Ph.D., University of Missouri.

Timm L. Kainen, Professor; B.A., Connecticut State University; M.A., University of Hartford; Ph.D., University of Massachusetts Amherst.

M. Riaz Khan, Professor; B.S., M.S., University of Karachi; M.A., M.B.A., Ph.D., State University of New York at Buffalo.

Valerie Kijewski, Associate Professor; B.A., Boston College; M.A., Ph.D., Indiana University.

Sanghill Kim, Assistant Professor; B.A. Yor-Sei University; M.B.A. University of Santa Clara; Ph.D., Ohio State University.

Linda H. Kistler, Professor; B.S., M.S., Colorado State University; C.P.A. (Massachusetts).

David A. Lewis, Professor; B.S.I.E., Northwestern University; M.S.I.E., University of Texas at Arlington; Ph.D., University of Massachusetts Amherst.

Goang-Tzer Liaw, Associate Professor; B.A., National Taiwan University; M.A., University of Minnesota; Ph.D., University of Illinois.

Efrem G. Mallach, Associate Professor; B.S.E., Princeton University; M.B.A., Boston University; Ph.D., Massachusetts Institute of Technology.

Stuart L. Mandell, Commonwealth Professor Emeritus; B.A., Brooklyn College; M.B.A., Syracuse University.

Joyce S. Mehring, Associate Professor; B.A., Bucknell University; M.S., University of Michigan; Ph.D., Massachusetts Institute of Technology.

James P. Monahan, Professor; B.S., M.B.A., Boston College; Ph.D., Columbia University.

Martin R. Moser, Associate Professor; B.A., City College of New York; M.A., Antioch Graduate School of New England; Ph.D., University of Massachusetts Amherst.

Leo L. Pipino, Associate Professor; B.S.E.E., Manhattan College; M.S.E.E., Northeastern University; Ph.D., University of Massachusetts Amherst.

Norma Powell, Associate Professor; B.S., University of Houston (Clear Lake); M.S., University of Houston; Ph.D., Texas A & M University; C.P.A. (Texas).

Santo J. Pullara, Professor (Emeritus); B.S., M.B.A., J.D., Ph.D., Syracuse University.

Yash R. Puri, Professor; B.Sc., M.Sc., Delhi University; M.B.A., D.B.A., Indiana University.

Irwin A. Shapiro, Professor; B.S., Syracuse University; M.B.A., Indiana University; M.A., Ph.D., Clark University.

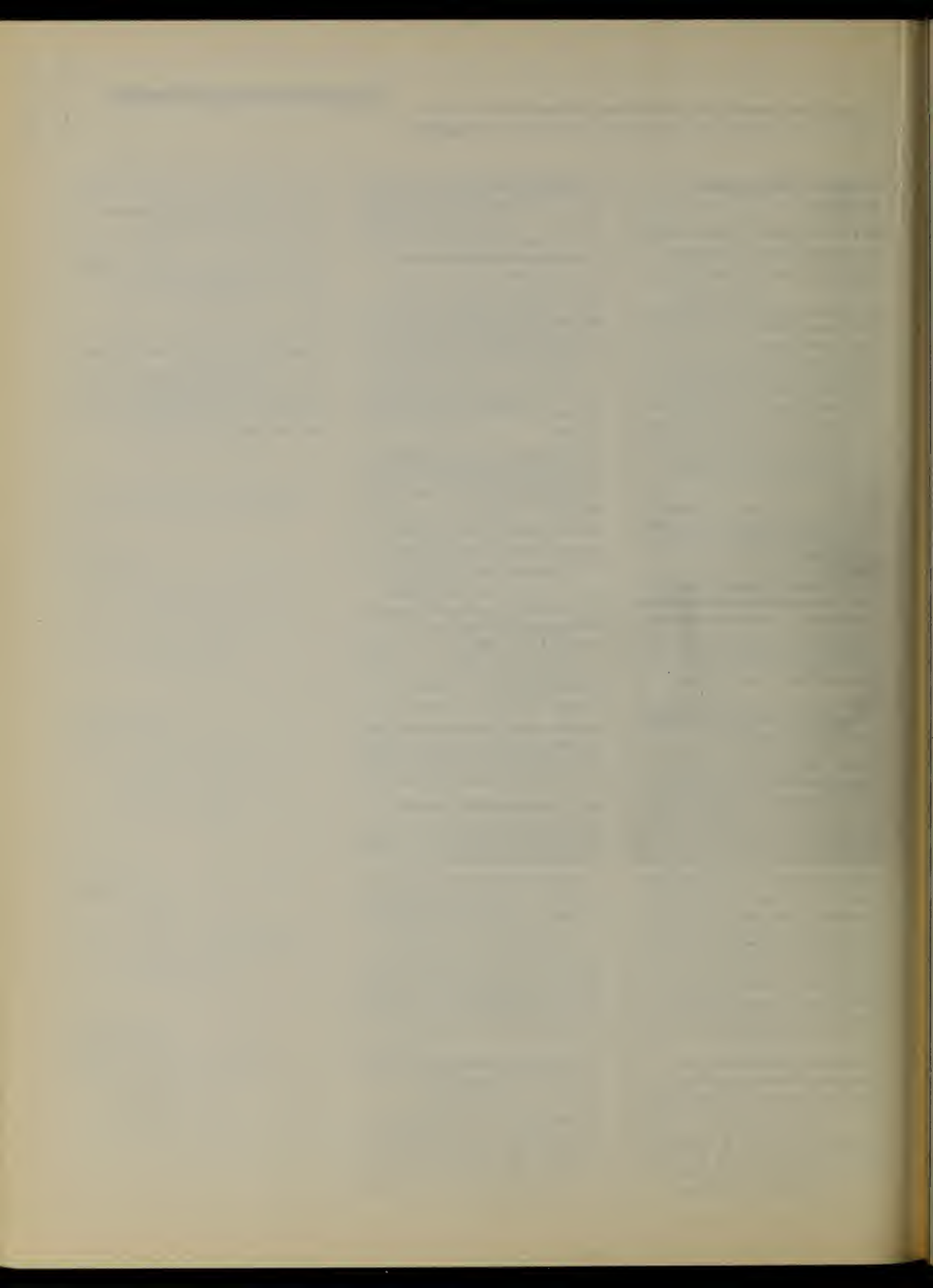
Sherre Strickland, Associate Professor; B.B.A., M.B.A., Lamar University; Ph.D., Texas A & M University; C.P.A. (Texas).

Charles F. Thompson, Associate Professor; B.S.A., Bentley College; M.B.A., Northeastern University; C.P.A. (Massachusetts).

Kathryn M. Verreault, Associate Professor; B.S., University of Lowell; M.B.A., Ph.D., Texas A & M University.

Louis E. Yelle, Professor; B.S., Lowell Technological Institute; M.S., M.B.A., Northeastern University.

Eunsang Yoon, Associate Professor; B.A., Seoul National University; M.B.A., University of Georgia; Ph.D., Pennsylvania State University.



University College



University College was founded in 1994 to provide students and professionals with a wide range of options for accessing the dynamic advancement opportunities at UMass Lowell. The following departments are located within University College: Freshman Programs, Centers for Learning and Academic Support Services (CLASS), Honors Program, Academic Computing, Division of Continuing Education, and the Faculty Teaching Center. This innovative approach to undergraduate education features a mix of traditional and experimental programs designed to enable UMass Lowell's students to take their place as leaders in the region's industry and community organizations.

Jacqueline Moloney, Dean

College Mission

The purpose of University College is to enable students to develop their educational and professional credentials at a flexible pace in day or evening programs throughout their lifetimes. University College offers a wide range of academic services and programs designed to enable students to excel at the university level. Experienced faculty and professional advisors consult with students to create educational plans that maximize the opportunities and support services available at UMass Lowell. In addition to personalized support services for students, the College enables the faculty to foster interactive teaching strategies, encourage the use of technology in the classroom, and develop new courses, degree and certificate programs.

Freshman Programs

The office of Freshman Programs offers a range of programs that facilitate transition into the University to first-time students in the day school.

Freshman Programs' Transitional Tracks

Freshmen, Encore and Educational Opportunities Program

Strategies for Success

Freshman Placement Testing

Transitional Tracks Academic Policies

The University College Transitional Programs serve as pathways to all undergraduate majors and are designed for students who are undecided or who prefer a program of study that emphasizes individualized academic assistance. For adult learners, University College facilitates the transition into college. Candidates whose potential and motivation for higher education indicate an acceptable probability of academic success are accepted into the University College. To be considered, applicants must follow the regular application procedures for day school programs.

Admissions Criteria

Admission of first time freshmen into University College will be allowed only in cases when a student's potential for academic success has been clearly demonstrated. Students may have SAT/ACT scores below the UML minimum or may have a high school G.P.A. of less than 2.75. University College recognizes that substantial strength in one academic indicator may allow some flexibility when interpreting a student's overall academic profile for acceptance. Admission of transfer students into University College will be allowed for freshmen students who have demonstrated college success. To be eligible for admission, a transfer student must possess high school credentials that are equivalent to the standards of admission of first time freshmen to the University and the student must have earned a grade point average of 2.0 for college courses.

The Encore Program is designed to allow adult students to begin or continue their education as part-time students (3-11 credits/semester) in the undergraduate day school. Individuals who have obtained a high school diploma at least three years prior to applying, the equivalent G.E.D., or who have attended college at least two years prior to their application for Encore are admitted for a transitional program of study.

Transitional programs of study for adult learners (Encore) are developed by the students in consultation with University College advisors who will determine whether the student should be admitted for a 15 or 30 credit transitional program and may require an interview with applicants. The curriculum is individually designed to bring the student into the major of his or her choice by highlighting specific strengths and addressing any weaknesses. Students who have completed 15 or more semester credits at an accredited college or University within the previous ten years are admitted into a transitional program of 15 credits. Students who have completed fewer than 15 credits at an accredited college within the previous ten years, or who have never attended an institution of higher education, are admitted to pursue a transitional program of 30 credits.

The Educational Opportunities Program (EOP) is designed for non-traditional,

under-represented students whose high-school preparation for the University curriculum of their choice has been inappropriate and/or whose high-school achievement and SAT scores demonstrate a need for support services. Students whose credentials do not meet the requirements for University College may be reviewed by the EOP staff.

Students who enter the Educational Opportunities Program must meet the credentials established by the Admissions Office.

English as a Second Language (ESL) students must have a minimum score of 500 on the Test of English as a Foreign Language (TOEFL). In cases where a student's language ability is questionable, UML will require an additional measurement of language proficiency administered by UML's ESL coordinator.

Program Requirements—Freshmen

Students admitted to University College must sign a contract which stipulates the following program requirements:

All students must fulfill the minimum University competency in mathematics and English. In addition, students will be required to pass Values and Creative Thinking(59.101), a course designed to enhance the ability to be successful at the University (Students who have at least two years of life experience beyond high school may place out of this requirement). Students may be required to participate in support services, i.e., supplemental instruction, tutoring, and study skills workshops, in order to improve their potential for success.

Academic Standing and Review

At the end of each semester of full-time enrollment (or after 12 attempted credits for part-time students), the record of each University College student is reviewed by the University College advisor. First-time and transfer students must be able to: achieve a grade of C or better in Values and Creative Thinking, satisfactory completion of English and math courses, and demonstrated competency in supplemental instruction. This progress must be achieved by the end of their second semester. Students whose progress is determined

College Policies and Requirements

to be inadequate by these criteria will be notified by University College advisors. If it is determined that the student will be unable to successfully complete the requirements, he or she will be dismissed from the University.

Transitional Program Qualifications for Transfer into a Major Department

By the end of their fourth semester (or equivalent for part-time enrollment, 48 credits), all University College students are transferred into a major department of the University. Students are required to have met the following criteria: earned 30 credits of CD or better, 15 of which must be of a 'C' grade or better, and a grade of 'C' or better in Values and Creative Thinking. In order to declare a major, students must meet the departmental requirements for intercollegiate transfer. Once these program requirements have been met, all D and F grades and credits will be removed from the calculation of the student's cumulative GPA. The resulting GPA must be 2.0 or better. Students who fall below this standard by not more than 0.2 may appeal to the University College Appeals Board.

Students unable to meet these requirements by the end of their fourth semester (or equivalent for part-time enrollment), will be dismissed from the University.

Students who achieve superior academic standing in their first semester may petition to transfer into their intended major earlier in their program of studies upon approval by the Dean of their intended college.

University College advisors will assist students throughout the transfer process to determine the students' eligibility for acceptance into departments. The department chairperson will review and evaluate each student's credentials and return a signed form of acceptance to the University College advisor. Only then will the student be officially transferred from University College to another college at the University.

Strategies for Success

Strategies for Success is a series of innovative orientation programs and seminars targeted to college survival offered throughout the freshman year. The series is a collaborative outreach program that combines the expertise of faculty, staff, and students. The workshops are designed to be an in-depth academic orientation for freshmen. Workshops on study skills, academic policy, and general educational requirements, as well as the use of computer labs, academic software, word processing, and tutoring are presented.

Freshman Placement Testing

All incoming freshmen are tested in math and English. The results are made available to the college deans and department chairs so that all students will be placed into the appropriate first semester math and English classes. All testing is completed prior to orientation and registration. Incoming freshmen are encouraged to take the language proficiency test. Advanced college credits are awarded to those students who achieve satisfactory scores.

The Centers for Learning and Academic Support Services

The Centers for Learning, established to improve the quality of academic experiences for students at UMass Lowell, have received national recognition for their innovative approach to academic support services and for the unique partnership that the Centers have with the faculty. The development of the programs has always been guided by the faculty who determine priorities and who study the effectiveness of the services provided. The Centers are comprised of three program components: Educational Computing & Multimedia, Tutoring Services & Supplemental Instruction, and the Advising Center.

Educational Computing & Multimedia

Computer labs are equipped with a variety of Macintosh and Windows '95 computers with mainframe connectivity for both faculty and students. Technical assistance on

software programs related to languages, statistics, desktop publishing, graphics, tutorial software, and word processing is available. Software packages in Physics, Calculus, Chemistry, Biology and many more subjects is available on both campuses.

Multimedia technology integrates sound, animation, video, text and graphics into a single presentation with a computer. Workshops are available to faculty and students to show how multimedia can enhance reports and presentations.

Tutoring Services & Supplemental Instruction

Peer Tutors work with students to clarify course content in high risk courses. Students should bring completed homework for review and assistance. Sample exams and faculty review sessions are a few highlights of our program. Writing services are also offered to students in all phases of the writing process.

Supplemental Instruction (SI) is an academic assistance program for students designed to increase academic performance and retention through its use of collaborative learning strategies. Supplemental Instruction is designed to help students succeed academically by combining content tutoring with study skills training. Since SI is not remedial, all students are encouraged to attend.

Advising Center

The Advising Center seeks to provide students with the information and advice necessary for them to make informed decisions when planning their educational careers. Advising is available to students who need assistance regarding academic program requirements, choice of major, intercollegiate transfer, registration, and career goals. Study skills workshops are also available on a drop-in basis. Workshops cover such topics as: time management, reading comprehension, note-taking techniques and test-taking strategies. A lending library of study skills books, workshops and career books and videos is also available for student use. The Centers also make available an Advising Handbook, Instructional Strategies Handbook, classroom technology, and a resource library.

The Honors Program

The Honors Program was established to provide enriched academic opportunities to meet the educational needs of exceptionally talented students and to foster the pursuit of scholarly excellence in undergraduate higher education. By fostering interactions among outstanding, motivated students and outstanding, dedicated faculty, the Honors Program is directed toward the recruitment, development, guidance, retention and professional growth of gifted students in activities designed to enhance their critical, cognitive and creative potential.

The University requires that incoming freshman honors students meet two of the following conditions: 1) a combined SAT score of 1200 or better (or ACT score of 26 or better); 2) graduation in the top 15 percent of their high school class; 3) at least two written recommendations from principals, high school counselors or senior teachers.

Transfer into the Honors Program is also permitted up to the first semester of the junior year. To graduate with an Honors degree, a student must: 1) complete 24, 18, or 15 credits depending on the total number of earned credits upon entrance into the program; 2) maintain a cumulative GPA of 3.25 or higher; 3) complete an honors thesis project.

Students who are not members of the Honors Program may also participate in honors courses. Such honors courses are provided in four forms: (i) Designated Honors Courses; (ii) Honors Sections of regular courses; (iii) Contract Honors for individual students desiring to take a given course at an elevated level, and (iiii) Directed Studies/collaborative faculty-student research projects.

Mindful of the needs of highly motivated students, the University has designated Honors floors in the residence halls that are consistent with both the academic and social needs of students. Our Residence Life program offers extra-curricular activities of specific interest to honors students.

The Program emphasizes a personalized approach to small classes and aims to bring out the very best in students who strive for the highest accomplishments.

Academic Computer Center

The Academic Computer Center (ACC) provides computer services for all UMass Lowell students, staff and faculty. Services on the VAX/VMS mainframe computers known as "Woods" include electronic mail (POP3 mail server), connection to the Internet and the World Wide Web (Lynx). A Web server for staff and faculty home pages, the Gopher bulletin board service, a Usenet reader, statistical analysis utilities (Mintab and SPSS) and programming languages like C, C++, Fortran and Pascal.

Macintosh and PC computers provide access to the Internet and World Wide Web (Netscape), word processing, graphics, spreadsheet programs, and C/C++ compilers.

The ACC Library has manuals available for all of the software supported by the ACC. The ACC also publishes a comprehensive VAX/VMS User's Guide which is available in the Barnes & Noble Bookstore.

Any student can apply for an account at the ACC. Computer accounts are valid for the duration of a student's stay at the University—that is, files are NOT erased between semesters. One computer account is all that is needed for email, Web access and all course work.

Continuing Education

Building on its expertise in delivering education to off-campus customers, the University College Continuing Education is now seeking new partners to enhance our region's prosperity.

The Division of Continuing Education, with over 20,000 credit course enrollments annually in a variety of educational programs, offers twenty-five degree programs at both the associate and baccalaureate levels, twenty-nine certificate programs, and credit for part-time, non-matriculating students. Undergraduate courses are offered in the fall and spring semesters, during an intensive three-week Winter Intersession, and two six-week summer terms (both day and evening). Additional offerings include Summer Graduate courses, Summer Writing Programs, and a number of cybereducation and distance learning courses.

In addition, Community Education offer-

ings include courses for adults whose interests range from personal enrichment to professional advancement.

The Professional Institutes Program designed for people seeking recertification or career updating, features specialized offerings such as: PC User Institute, Multimedia User Institute, Entrepreneurship Institute, Health Care Institute, Teacher Recertification, and Executive Seminars.

The Office of Special Programs manages over 150 professional development seminars and conferences, frequently showcasing University of Massachusetts Lowell faculty and departments.

At present, Continuing Education courses are offered on the main campus in Lowell, the Mogan Center, the Woods Hole Oceanographic Institute, and various on-site business locations. Brochures listing all credit course offerings are available approximately six weeks prior to each semester's opening date.

The Faculty Teaching Center

The Faculty Teaching Center is sponsored by the Council on Teaching, Learning, and Research as Scholarship, a group of over 70 faculty members. The mission of the Center is to promote excellence in teaching and learning by providing opportunities for faculty to meld disciplinary expertise and classroom experience with professional teaching knowledge.

The Center provides services and programs designed to support teaching and learning and faculty development.

*Faculty/Staff***Staff**

Jacqueline F. Moloney, Dean; B.S., University of Lowell; M.A., Goddard College; Ed.D., University of Massachusetts Lowell

Mary L. Beaudry, Director of the Faculty Teaching Center; B.S.Ed., Bridgewater State College; M.A.T., Salem State College; Ed.D., University of Massachusetts Lowell

Pauline A. Carroll, Associate Director of Continuing Education; B.A., University of Lowell; M.A., Brown University

Robin Desmond, Coordinator of Registration and Student Services for continuing Education; B.S.B.A., University of Massachusetts Lowell; B.L.A., University of Massachusetts Lowell; M.Ed., University of Massachusetts Lowell

Susan Desmond, Academic Counselor for Continuing Education; A.A., Middlesex Community College; B.A., University of Massachusetts Lowell; M.Ed., University of Massachusetts Lowell

Richard Desroches, Director of the Academic Computer Center; B.S., University of Massachusetts at Amherst; M.L.S., University of Rhode Island

James S. Donohoe, Dean of Freshmen, A.B., Providence College; M.Ed., Ed.D., Northeastern University

David Driscoll, Coordinator for Multimedia, Communications, and Training; B.A., University of Massachusetts Lowell

Veronica Gadbois, Coordinator of Honors Programs; B.A., University of Lowell

Catherine Galaitsis, Manager of Special Programs; B.A., Middlebury College

Howard Kaplan, Director of Educational Computing; B.A., City College of New York; M.A., California State University, Sonoma; Ed. D., University of Massachusetts at Amherst

Catherine Kendrick, Director of Marketing and Professional Institutes; B.A., Regis College; M.A., Tufts University

Gloria Johnson, Director of Educational Opportunities Program; B.S., New York University; M.A., New York University

Susan O. Lemire, Coordinator of Language and Learning Strategies; B.A., Merrimack College; M.A., College of William and Mary

James Lyman, Staff Assistant for Educational Computing; B.S., University of Massachusetts at Amherst

David McSwain, Staff Assistant for Educational Computing

Lisa Mahoney, Assistant Director of Educational Computing; B.A., University of Lowell; M.A., Rivier College

Dirk Messelaar, Director of Continuing Education; A.B., University of Massachusetts; M.Ed., Ed.D., Boston University

William R. Pero, Coordinator of Tutoring Services; B.A., Salem State College; M.Ed., Boston University

Sheila A Riley-Callahan, Director of Academic Services; B.A., M.Ed., University of Lowell

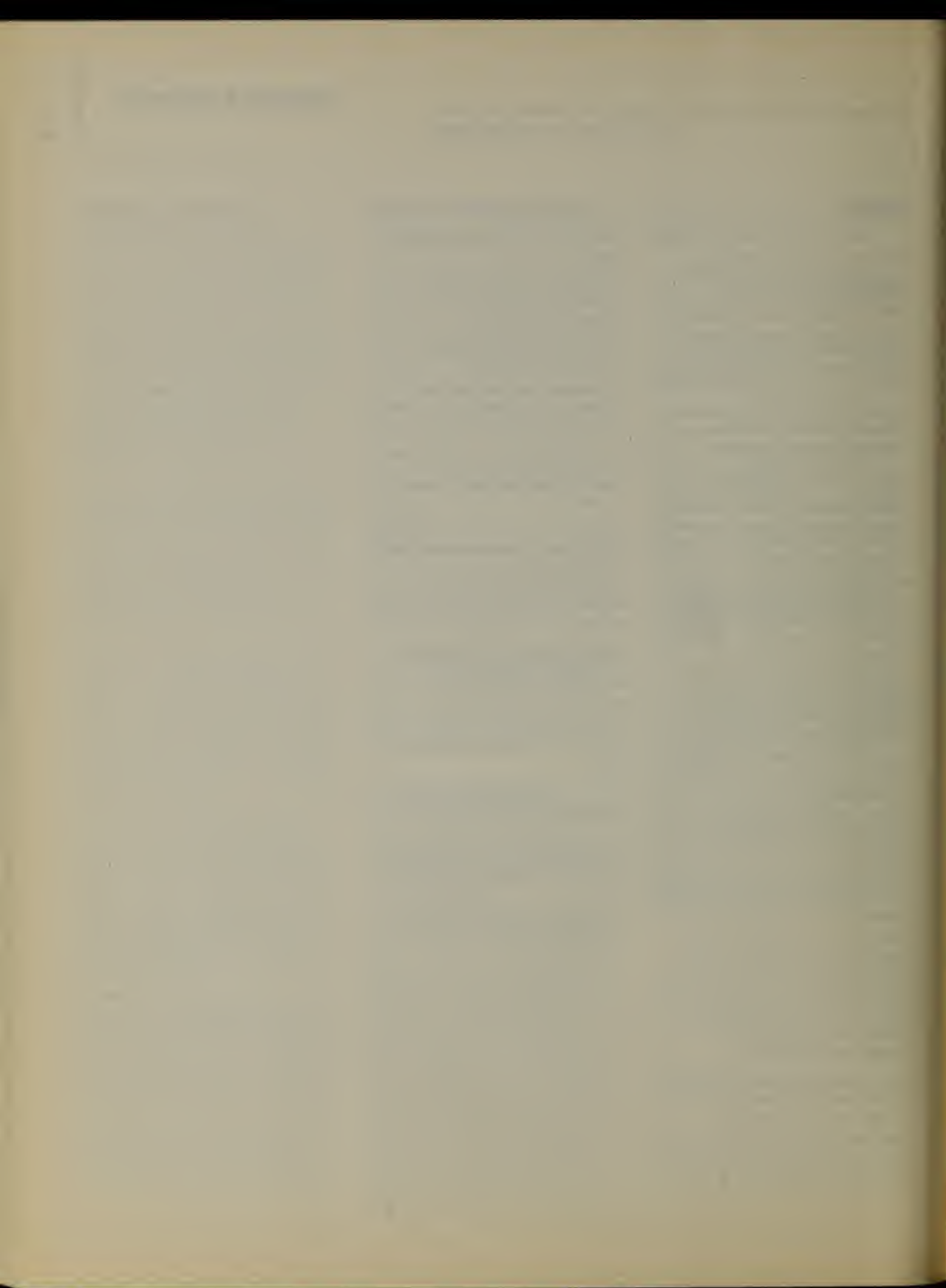
Gregory Rushton, Project Manager; B.S., Civil Engineering, University of Massachusetts Lowell

Erik B. Shaw, Staff Coordinator/Transitional Programs; B.A., Saint Augustine's College; M.A., University of Lowell

Steven Tello, Multimedia/Corporate Training Specialist; B.A. University of Lowell; M.Ed, Cambridge College

Kimberly P. Vitchkoski, Assistant Director of Academic Services; B.A., Heidelberg College; M.A., Middlebury College

Amy Yacus, Manager of Marketing and Outreach; B.A., Simmons College



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Robert B. Wagner, Provost; B.S., Ohio
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Paul W. Rahmeier, Associate Provost; A.B.,
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Lisa M. Johnson, Assistant Vice Chancellor
for Academic Affairs for Enrollment
Management; B.S., Framingham State;
M.S., Miami University; Ph.D., Michigan
State University
Jerome Hojnacki, Dean, Graduate School;
B.S., Southern Connecticut State College;
M.S., University of Bridgeport; Ph.D.,
University of New Hampshire; M.H.A.,
Clark University

Nancy Kleniewski, Dean of Humanities
and Social Sciences, College of Arts and
Sciences; A.B., Emmanuel College; M.A.,
Ph.D., Temple University A.B., Emmanuel
College; M.A., Ph.D., Temple University

Gerald J. Lloyd, Dean, College of Fine
Arts; B.M., M.M., College-Conservatory of
Music, University of Cincinnati; Ph.D.,
Eastman School of Music, University of
Rochester

Jacqueline F. Moloney, Dean, University
College; B.A., University of Lowell; M.A.,
Goddard College; Ed.D., University of
Massachusetts Lowell

Donald Pierson, Dean, College of
Education; A.B., Princeton University;
Ed.M., Ph.D., Harvard University

Janice M. Stecchi, Dean, College of Health
Professions; R.N., B.S., Boston College;
M.Ed., Salem State College; M.S., Ed.D.,
Boston University

Robert H. Tamarin, Dean of Sciences,
College of Arts and Sciences; B.S.,
Brooklyn College of the City, University of
New York; Ph.D., Indiana University

Kathryn Verreault, Interim Dean, College
of Management; B.S., University of Lowell;
M.B.A., Ph.D., Texas A & M University

Millicent Kalaf, Director of Institutional
Research; B.A., University of Rochester;
M.A., Harvard University

Krishna Vedula, Dean, College of
Engineering; B. Tech., Indian Institute of
Technology, Bombay, India; M.S., Drexel
University, Ph.D., Michigan Tech.
University

Office of Enrollment Management

Lisa M. Johnson, Assistant Vice Chancellor
for Academic Affairs for Enrollment
Management; B.S., Framingham State;
M.S., Miami University; Ph.D. Michigan
State University

University Directory



Office of Admissions

Rayanne Drouin, Assistant Director of Admissions and Coordinator of Special Programs; B.A., University of Massachusetts Lowell; M.Ed., University of Massachusetts Lowell

Gerald J. Durkin, Director of Transfer Admissions; B.S., Lowell State College; M.Ed., University of Massachusetts Lowell

Julia Fuce, Associate Director of Transfer Affairs and Coordinator of Joint Admissions; B.A., Lowell State College; M.A., University of Lowell

Office of Enrollment Services

Donald R. Donati, Director of Academic Information and Enrollment Services; B.S., U.S. Merchant Marine Academy; M.S., Ph.D., Lowell Technological Institute

Janet A. King, Associate Registrar; BA, MSA, St. Michael's College

Joseph Antonuccio, Assistant Registrar; B.S., Lowell Technological Institute

University Libraries

Bernard Franckowiak, Director of Libraries; B.S., University of Wisconsin, Oshkosh; M.L.S., George Peabody College; Ph.D., University of Wisconsin, Madison

John Callahan, Systems Librarian; B.A., Clark University; M.L.S., SUNY Albany

Joanne Carpenter, Government Documents Librarian; A.B., Radcliffe/Harvard College; M.L.S., Simmons College

Paul Coppens, Head of Media Services; B.S.E., M.S.E., Northern Illinois University

John Hill, Business/Reference Librarian; B.C., M.L.S., University of New South Wales; M.B.A., University of Massachusetts Lowell

Helen Jones, Head, Public Services; B.A., University of Buffalo; M.A., University of Minnesota; M.B.A., University of Lowell

Ronald Karr, Social Science Reference Librarian; B.A., Bucknell University; M.A., Ph.D., Boston University; M.S., Simmons College

Roseanna Kowalewski, Education Reference Librarian; B.S., Lowell State College; M.L.S., Simmons College; C.A.G.S., Boston University

Margaret Manion, Engineering/Reference Librarian; B.A., SUNY Albany; M.L.S., Syracuse University; M.S., Northeastern University

Martha Mayo, Special Collections Librarian; B.A., University of Maine, Orono; M.S., University of Illinois, Urbana; M.Ed., University of Massachusetts Lowell

Marion Muskiewicz, Science Technology/Reference Librarian; B.S., Marietta College; M.A., University of Michigan; M.S., University of Lowell

Suzanne Nault, Head Technical Services; B.A., Merrimack College; M.A., M.S., Simmons College

Patricia Noreau, Periodicals/Series Librarian

Mitchell Shulman, Media Librarian; B.A., SUNY Cortland; M.S., Simmons College

Richard Slapsys, Music/Humanities Reference Librarian; B.A., Long Island University; M.A., City College of New York; M.L.S., Queens College of New York

Research Foundation

Louis J. Petrovic, Director, External Funding, Technology Transfer, and Partnering; B.S., Case Institute of Technology; M.S., Ph.D., Northwestern University; M.B.A., Boston College

Michael V. Accardi, Comptroller; B.S., St. John's University; CPA

Louise G. Griffin, Director, Grants and Contracts; B.S., University of Massachusetts Lowell; M.B.A., New Hampshire College

Jon A. Kimball, Coordinator, Program Development; B.A., Keene State College

Community Outreach for Performing and Visual Arts

Christine Heaton Brown, Director of Community Programs for Performing and Visual Arts; A.B., Monmouth College; M.S., Southern Illinois University

Office of the Vice Chancellor for Administration and Finance

Susan A. Goodwin, Vice Chancellor for Administration and Finance; A.B., Wellesley College; M.A., Boston University; Ph.D., Tufts University

Daniel B. Brosnan, Budget Manager; A.B., Merrimack College; M.P.A., Pennsylvania State University; M.B.A., University of Massachusetts Lowell

Karen Carter, Financial Accountant; B.S., University of Lowell; C.P.A.

Nancy Fowler, Intrim Director of Administrative Computing; B.S., M.Ed.; University of Massachusetts Lowell

John Giarusso, Director of Human Resources; B.S.Ed., Worcester State College; M.P.A., Clark University

Charles J. Gisondi, Campus Comptroller and Manager of Treasury Services; B.S.A., Bentley College; CPA

Douglas Heifner, Director of Administrative Services; M.B.A., Nichols College; B.B.A., University of Massachusetts Amherst

Judy Keyes, Director of Student Financial Assistance; B.S. Franklin Pierce

Mark D. Malkasian, Facilities Manager; B.S., Northeastern University; M.E., University of Florida

Cecile Paquin, Manager of General Accounting

John Perroni, Assistant Comptroller and Director of Treasury Services; B.S., Villanova

University Directory



James W. Rowe, Sr., Director of Public Safety; B.S., St. Anselm College; M.P.A., Golden Gate University

Janet Sawyer, Director of Accounts Receivable; A.B., Brown University; A.M., Harvard University

M. Jeannie Tremblay, Manager of Purchasing; B.S., University of Massachusetts Lowell

Raymond A. Vigeant, Director of University Telecommunications; B.S., Wentworth Institute; M.S., Northeastern University

George Zaharoolis, Director of Accounts Payable and Receivable

Fran Zannoni, Accountant, Payroll

Office of Student Services

Ellen C. Duggan, Associate Dean of Students; A.B., M.Ed., Rivier College

Kristen Amman, Assistant Director of Career Services; B.S., M.Ed., University of Massachusetts Lowell

John Bayliss, College Counselor and Staff Psychologist; B.A., M.A., San Francisco State University; M.A., Goddard College; Ph.D., Columbia Pacific University

John E. Burke, Assistant Director of Career Services; B.S.B.A., M.A., University of Massachusetts Lowell

Noel Cartwright, Director of Counseling and Career Development; A.B., University of Queensland; S.T.M., Ph.D., Boston University

Annie Ciaraldi, Associate Director of Residence Life; B.A., M.Ed., Plymouth State College

Mary Connelly, Director of Student Activities, Commuter Services, and Student Centers; B.A., University of R.I.; M.S., Central Connecticut State University

Elizabeth Donaghey, Director of Disability Services; B.A., M.Ed., University of Massachusetts Lowell

Eleanor Ellis, R.N.C.S., F.N.P., Nurse Practitioner; B.S.N., St. Anselm College; M.S., University of Massachusetts Lowell; Certified by the American Nurses Association

Brenda Evans, Assistant Director of Student Activities, Commuter Services, and Student Centers; B.A., M.A., University of Massachusetts Lowell

Elyse Lemaire, Staff Psychologist; B.A., University of Virginia; M.A., University of Florida; Ph.D., University of Florida

Nancy Quattrocchi, R.N.C.S., Director of University Health Services; B.S., Boston College; M.S., University of Lowell; Certified by the American Nurses Association

Lanette Crews Scott, College Counselor; A.B., Fisk University; M.A., Northeastern University; Ed.D., University of Massachusetts at Amherst

Andrew Scribner-MacLean, Associate Director of Residence Life; B.A., M.Ed., University of Lowell

Chandrika Sharma, Assistant Director of Disability Services; B.A., India, M.Ed., Keene State College; Ed.D., University of Massachusetts Lowell

Larry Siegel, Director of Residence Life and Student Development; B.S.W., SUNY at Stonybrook; M.Ed., Bowling Green State University

Thomas C. Taylor, Assistant Dean of Students; A.B., Colorado College; M.C.M., Denver Seminary

Rhoda Treitsch, Counselor; A.B., Douglass College; M.Ed., Rutgers University

Patricia Yates, Director of Career Services; B.A., UMass Amherst; MBA, Babson

Office of the Vice Chancellor for University Relations and Development

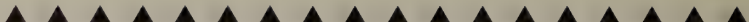
Frederick P. Sperounis, Vice Chancellor for University Relations and Development; B.S., Salem State College; M.A., Ph.D., Brandeis University

Mark D. Levine, Director of Community Service; A.B., Brandeis University; M.S., City College of New York; Ph.D., Union Institute

Christine McKenna, Director of Communications; B.A. Boston State College; M.P.A., University of Massachusetts Boston

Donald G. Rizzo, Executive Director, University Advancement; B.A., Tarkio College; M.S., Bradley University

Where to Write for Further Information



All correspondence concerning the University of Massachusetts Lowell should be addressed to the appropriate office:

University of Massachusetts Lowell
One University Avenue
Lowell, MA 01854-2881

Academic Records and Transcripts

Dr. Donald Donati, Director Enrollment Services 508 934-2555

Academic Services

Ms. Sheila Riley-Callahan
Director of Academic Services
508 934-2946

Freshman Admissions

Ms. Rayanne Drouin
Assistant Director of Admissions
508 934-3944 1 800 410-4607

Transfer Admissions

Mr. Gerald Durkin
Director of Transfer Admissions
508 934-3942 1 800 410-4607

Career Services

Ms. Patricia Yates
Director of Career Services
508 934-2355

Counseling Services

Dr. Noel Cartwright
Director of Counseling
508 934-4331

Educational Opportunity Program

Ms. Gloria Johnson
Director of Educational Opportunity Program 508 934-2454

Financial Aid

Ms. Judy Keyes
Director of Financial Assistance
508 934-4232

Residence Halls

Mr. Larry Siegel
Director of Residence Life
508 934-2107

Student Services

Ms. Ellen Duggan
Associate Dean of Students
508 934-2100

Veterans' Benefits

Ms. Peggy McNamara
Office of Enrollment Services
508 934-2556

Catalogue of Undergraduate Studies



Catalogue of Undergraduate Studies

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Undergraduates are expected to be familiar with the contents of this publication and are personally responsible for complying with all rules and regulations of the University. Matriculating students are solely responsible for completing all degree requirements.

Policy statements, tuition and fee schedules and other information published in this catalogue of undergraduate studies reflect information which was current at the beginning of the 1997-98 academic year. Such statements and schedules are not intended to be and should not be relied upon as statements of University contractual undertakings. Although the University provides notice concerning changes of policy and tuition and fee schedules as is reasonably practicable under the circumstances, it reserves the right in its sole judgment to implement new rules and regulations and to make changes of any nature in its program, calendar, procedures, and standards, degree requirements, and academic schedule, including, without limitation, changes in course content and class schedules. The Office of Enrollment Services publishes current University academic policies in the "yellow pages" of the semester schedule of classes. Special announcements also are periodically released by departments, colleges, and the University, and when feasible, these are also published in the Connector, the student newspaper. Administrative policies of a system-wide nature (e.g., admissions policies, tuition) are subject to change without advance notice.

When changes are necessary, the University of Massachusetts Lowell exerts reasonable efforts to provide comparable or substantially equivalent instructional services and facilities for those originally designated. However, it assumes no liability for failure to deliver or for delay in delivering such services (including those in support of academic functions or student life) when the causes of such failure or delay are beyond the reasonable control of the University which causes include, without limitation, the following: power failure, fire, accident, natural disaster, work slowdown and strikes, loss of personnel, changes in funding, and acts of public authorities.

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1. The first part of the paper is devoted to a general discussion of the problem of the origin of life. It is shown that the problem is one of the most important and most difficult in the history of science. The author discusses the various theories of the origin of life, and shows that the most plausible is the theory of spontaneous generation.

2. The second part of the paper is devoted to a detailed discussion of the theory of spontaneous generation. The author shows that this theory is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor. The author also shows that the theory of spontaneous generation is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor.

3. The third part of the paper is devoted to a detailed discussion of the theory of spontaneous generation. The author shows that this theory is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor. The author also shows that the theory of spontaneous generation is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor.

4. The fourth part of the paper is devoted to a detailed discussion of the theory of spontaneous generation. The author shows that this theory is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor. The author also shows that the theory of spontaneous generation is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor.

5. The fifth part of the paper is devoted to a detailed discussion of the theory of spontaneous generation. The author shows that this theory is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor. The author also shows that the theory of spontaneous generation is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor.

6. The sixth part of the paper is devoted to a detailed discussion of the theory of spontaneous generation. The author shows that this theory is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor. The author also shows that the theory of spontaneous generation is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor.

7. The seventh part of the paper is devoted to a detailed discussion of the theory of spontaneous generation. The author shows that this theory is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor. The author also shows that the theory of spontaneous generation is based on the fact that life is a complex of many different parts, and that these parts are all derived from a common ancestor.

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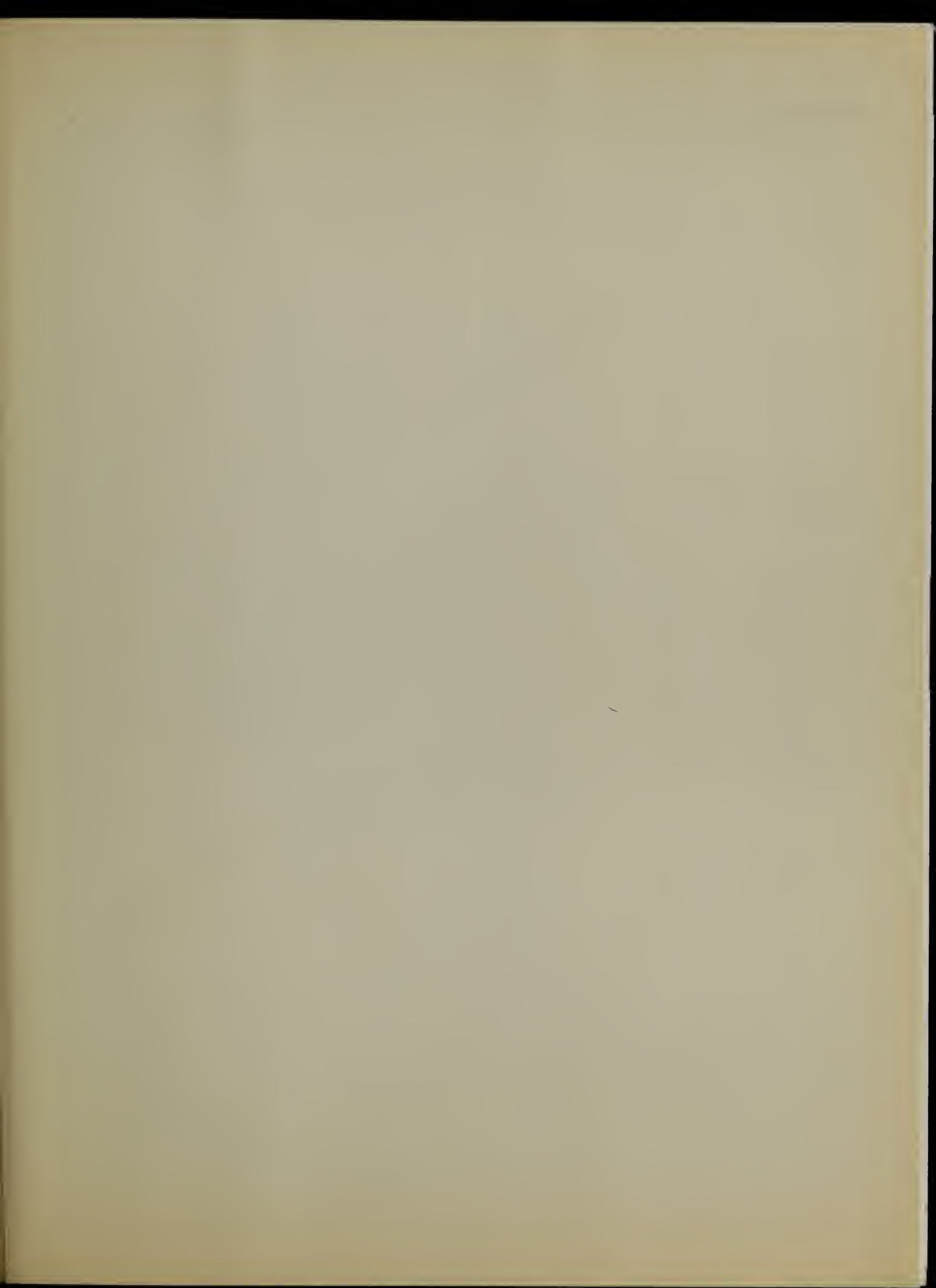
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UNIVERSITY OF
MASSACHUSETTS
LOWELL

One University Avenue
Lowell, MA 01854